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TO

THE UNIVERSITY OF TORONTO

BY

Dr. Graham Campbell.

Colin G. Campbell.

Edinburgh. -/85

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[Bruce, John Mitchell]
[Materia medica and therapeutics, an introduction to the rational treatment of disease]
vol 2
Lond., Cassell, 1884

83265
18/9/07

cooling. (1) $3C_5H_{12}O + 8H_2SO_4 + 2K_2Cr_2O_7 = 3C_5H_{10}O_2 + 2(K_2SO_4.Cr_23SO_4) + 11H_2O$. (2) $C_5H_{10}O_2 + NaHO = NaC_5H_9O_2 + H_2O$.

Characters.—Dry white masses, not alkaline; soluble in spirit.

Impurities.—Sulphuric acid, and free soda, detected by litmus.

Dose.—1 to 5 gr.

From Sodæ Valerianas is made:

Zinci Valerianas.—Valerianate of Zinc. $Zn(C_5H_9O_2)_2$.

Source.—Made by mixing solutions of Sulphate of Zinc and Valerianate of Soda, evaporating, and crystallising. $ZnSO_4 + 2(NaC_5H_9O_2) = Zn2(C_5H_9O_2) + Na_2SO_4$.

Characters.—Pearly crystalline scales, with a feeble odour of valerianic acid, and a metallic taste. Scarcely soluble in water, soluble in spirit.

Impurities.—Sulphate and butyrate of zinc.

Dose.—1 to 3 gr.

ACTION AND USES.

Valerian acts essentially like other substances containing volatile oils, but its pungent taste and peculiarly disagreeable odour add to the effect of the drug upon the central nervous system. The stomach and intestines, heart, circulation, and brain are influenced as they are by cloves (see *Caryophyllum*), and the oil is excreted, like its allies, in the urine, breath, and sweat, as is also the valerianic acid.

Valerian is used as a powerful **carminative, circulatory stimulant, and antispasmodic,** in hysterical flatulence, fainting, palpitation, convulsions, and contractures. It is now but rarely given in other spasmodic affections, such as epilepsy, pertussis, and asthma. Valerianate of zinc was introduced to combine the alterative action of the metal on the nervous system with the antispasmodic influence of valerian root, and has been given in hysteria and epilepsy. Valerianic acid, however, does not appear to possess any of the action of the volatile oil just described.

COMPOSITÆ.

Pyrethri Radix—Pellitory Root.—The root of Anacyclus Pyrethrum, imported from the Levant.

Characters.—In pieces about the length and thickness of the little finger, covered with a thick brown bark, studded with

black shining points. Breaks with a resinous fracture, and presents internally a radiated structure. When chewed, it excites a prickling sensation in the lips and tongue, and a glowing heat.

Substance resembling Pellitory: Taraxacum, which is darker and of different taste.

Composition.—Pyrethrum contains one or more *æthereal oils* and *resins*, *inulin*, and possibly a substance allied to *piperin*. See *Piper Nigrum*, page 329.

Preparation.

Tinctura Pyrethri.—1 in 5.

ACTION AND USES.

Pellitory causes a sharp burning sensation in the mouth, followed by persistent tingling and numbness, and a profuse flow of saliva, stimulating as it does the local nerves and vessels and afterwards depressing the former. It has been used only for these local effects, to relieve pain and paralysis in connection with the mouth, and as a **sialagogue** to promote a gentle flow of saliva in dryness of the throat. It gives a "clean" taste to flat dentifrices, such as chalk.

Pyrethrum Roseum (*Not Officinal*). — The powder of the flower-heads used as insect powder.

Santonica — Santonica, — The unexpanded flower-heads of an undetermined species of Artemisia. Imported from Russia.

Characters.—Flower-heads rather more than a line in length and nearly half a line in breadth, fusiform, blunt at each end, pale greenish-brown, smooth; resembling seeds in appearance, but consisting of imbricated involucral scales with a green midrib, enclosing four or five tubular flowers; odour, strong; taste, bitter, camphoraceous. Flower-heads not round or hairy.

Composition.—Santonica contains *santonin*, and a compound *volatile oil*, allied to camphor in its action.

Dose.—10 to 60 gr.

From Santonica is made:

Santoninum, Santonin. $C_{15}H_{18}O_3$. A neutral principle obtained from Santonica.

Source.—Made by (1) boiling Santonica with Lime, and straining; (2) acidulating the hot concentrated fluid portion with

Dialogue.

Anthelmintic.
Causes yellow vision.

Hydrochloric Acid, to precipitate the santonin; (3) washing this with Ammonia and water, and drying; and (4) dissolving it in spirit, purifying with charcoal, and crystallising out.

Characters.—Brilliant, white, four-sided flat prisms, becoming yellow by exposure to light; odourless, tasteless or feebly bitter; scarcely soluble in cold water.

Dose.—1 to 4 gr. for a child; 2 to 6 gr. for an adult.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Santonin acts as a poison to the *Ascaris lumbricoides*, or round worm, which infests the intestine; decidedly less so to the *oxyuris vermicularis*, or thread-worm. It is used as our most valuable **anthelmintic** against the former parasite, either combined with a purgative vermifuge, such as Pulvis Scammonii Compositus, or followed in a few hours by a laxative, such as castor-oil.

2. ACTION IN THE BLOOD, AND SPECIFIC ACTION.

Santonin is absorbed into the blood as sodium santonate; enters the tissues; and produces peculiar **disturbances of vision** and the cerebral faculties. Objects appear first as blue, and then as yellow (chromatopsia), and finally colour vision is almost lost. **Consciousness is disturbed,** with a kind of intoxication, tremors, debility, and convulsions after large doses. Respiration is enfeebled, and the pulse reduced in frequency. These effects must be carefully avoided in ordering santonin as an anthelmintic.

3. REMOTE LOCAL ACTION.

Santonin is excreted by the kidneys as an obscure product of its oxydation in the system, which colours the (acid) urine greenish-yellow, alkaline urine red or purple, and causes some diuresis.

Anthemidis Flores—CHAMOMILE FLOWERS.—The dried single and double flower-heads of the common chamomile, Anthemis nobilis. Wild and cultivated.

Characters.—The single variety consists of both yellow tubular and white strap-shaped florets; the double, of white strap-shaped florets only; all arising from a conical scaly receptacle; both varieties, but especially the single, are bitter and very aromatic.

Composition.—Chamomile flowers contain the officinal bluish-coloured *volatile oil*, a complex compound of a peculiar camphor and various æthers and acids; and a *bitter extractive*, the active principle of which has not been separated.

Preparations.

1. **Extractum Anthemidis.**—A concentrated decoction, with the addition of the Oleum. *Dose*, 2 to 10 gr.
2. **Infusum Anthemidis.**—1 in 20. *Dose*, 1 to 3 fl.oz. as stomachic; 5 to 10 as emetic.
3. **Oleum Anthemidis.**—The oil distilled in Britain from the flowers. *Dose*, 2 to 4 min.

ACTION AND USES.

Externally.—Warm infusions or decoctions, or the flowers in bags soaked in hot water, possess the general properties of fomentations and poultices, the warm water being apparently the active constituent. They are much used as a domestic application to painful parts.

Internally.—Chamomile belongs to the class of **aromatic bitter stomachics.** The warm Infusion, freely drunk, is a mild simple **emetic**, which may be used in biliousness, ague, etc. The Oil or the Extract is usefully combined with purgative pills as a stomachic and carminative.

Taraxaci Radix—Dandelion Root.—The fresh and dried roots of Taraxacum Dens Leonis. Gathered between September and February, from meadows and pastures in Britain.

Characters and tests.—Tap-shaped roots, smooth and dark-brown externally, white within, easily broken, and giving out an inodorous bitter milky juice, which becomes pale-brown by exposure.

Substances resembling Taraxacum: Aconite, Armoracia, Pellitory. Dandelion is not wrinkled or pale-coloured externally; the juice not watery; any adherent leaves runcinate and quite smooth; is not pungent when chewed.

Composition.—Taraxacum root and the fresh juice contain an indifferent principle *taraxacin*, amorphous or in small white masses; abundance of potassium and calcium *salts; sugar;* and *resinoid bodies* which give the milky appearance to the juice. The relative richness of the taraxacin, salts, and sugar varies with the season and situation.

Aromatic Bitter
Emetic

Bitter
Laxative.

Hydrastic.
Laxative.

Preparations.

1. **Decoctum Taraxaci.**—1 of *dried* root in 20. *Dose*, 2 to 4 fl.oz.
2. **Extractum Taraxaci.**—A fresh extract. 100 of *fresh* root in 8, by expression, separation of albumen, and evaporation. *Dose*, 5 to 15 gr.
3. **Succus Taraxaci.**—Fresh juice, 3; Spirit, 1. *Dose*, 2 to 4 fl.dr.

ACTION AND USES.

Taraxacum combines the properties of its two principal constituents, the bitter taraxacin and the alkaline salts, *i.e.* it is at once a simple **bitter** and a mild **laxative.** It is therefore indicated, and was formerly extensively given in atonic dyspepsia attended by habitual constipation; and its preparations may be added to stomachic mixtures and laxative pills. Until recently taraxacum was believed to be a cholagogue; but this effect, if it exist at all, appears to be indirect only.

Lactuca—Lettuce.—The flowering herb of Lactuca virosa, a native of Britain.

Composition.—Extract of lettuce contains, besides many other ingredients, a crystalline bitter principle, *lactucin*, and *lactucic acid*, of uncertain composition.

Preparation.

Extractum Lactucæ.—A green extract. 1½ in 1. *Dose*, 5 to 10 gr.

ACTION AND USES.

Lactucin is slightly **hypnotic.** The extract may cause some confusion of mind, headache, and diaphoresis; and acting as a mild sedative and **carminative**, it makes an excellent pill-basis for some purgatives, such as calomel.

Arnicæ Radix—Arnica Root.—The dried rhizome and rootlets of Arnica montana. Collected in the mountainous parts of middle and southern Europe.

Substances resembling Arnica: Valerian, known by smell; Serpentary, with very many contorted rootlets; Veratrum Viride, with thicker rootlets.

Characters.—Rhizome from one to three inches long, and two or three lines thick, cylindrical, contorted, rough from the scars of the coriaceous leaves, and furnished with numerous long slender fibres; has a peppery taste and peculiar odour.

Composition.—The pharmacology of arnica is still obscure. It contains a small quantity of *volatile oil*, of complex composition, and said to yield *trimethylamin; tannic acid;* and a bitter substance, *arnicin.*

Preparation.

Tinctura Arnicæ.—1 in 20. *Dose*, 1 to 2 fl.dr.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally.—Arnica, applied to the skin, sometimes causes hyperæmia, eczema, and even spreading erysipelas. It would, therefore, appear to **increase the activity of the circulation in the skin**; and the tincture in water is a popular application to bruises, preventing swelling, and hastening the absorption of effused blood. It must be used with caution.

Internally.—Arnica is a **stimulant to the alimentary canal**, like volatile oils in general; in over-doses a powerful irritant, causing vomiting, pain, and purging, with consequent constitutional effects. Probably by reflex action from the stomach (see *Caryophyllum*, page 242) it stimulates the heart and circulation, the brain and spinal cord, in moderate doses; the pulse being strengthened, and symptoms of nervous debility removed. Arnica has, therefore, been used with success in low forms of fever, delirium tremens, and mental disorder.

2. ACTION ON THE BLOOD, AND SPECIFIC ACTION AND USES.

The active principles of arnica enter the blood and thence the tissues, where its effects somewhat resemble those of turpentine. If the dose be considerable, the reflex stimulant effect from the stomach is overcome by its **depressing action on the circulation and nerve centres**; headache, unconsciousness, and convulsions being induced, and the body temperature lowered. Arnica has thus been employed as an antipyretic, especially in acute rheumatism, but cannot be said to be used now.

3. REMOTE LOCAL ACTION AND USES.

Like its allies, arnica is a remote stimulant of the kidneys and skin, and has been given in some cutaneous diseases such as eczema, and in chronic rheumatism.

The actions are probably due to the Spirit.

Gastro-intestinal Stimulant.
Depressor respiratory centre
Relaxes Bronchial Muscles

LOBELIACEÆ.

Lobelia—Lobelia.—The dried flowering herb of Lobelia inflata. Imported from North America.

Characters.—Stem angular; leaves alternate, ovate, toothed, somewhat hairy beneath; capsule ovoid, inflated, ten-ribbed; herb acrid. Usually in compressed rectangular parcels.

Composition.—Lobelia contains an active principle, *lobelina*, an oily, liquid, and volatile alkaloid, with a pungent taste, and an odour like tobacco. It forms salts with acids. *Lobelic acid* is united with the lobelina.

Incompatibles.—The caustic alkalies, which decompose lobelina.

Preparations.

1. Tinctura Lobeliæ.—1 in 8 Proof Spirit. *Dose*, 10 to 30 min.
2. Tinctura Lobeliæ Ætherea.—1 to 8 Spirit of Ether. *Dose*, 10 to 30 min.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Lobelia is a **gastro-intestinal stimulant**; in large doses an irritant, causing vomiting, pain, purging, and the ordinary symptoms of depression. It is not to be used as an emetic, but is sometimes useful in obstinate constipation.

2. ACTION ON THE BLOOD, AND SPECIFIC ACTION AND USES.

The active principles of lobelia appear to enter the blood and tissues, where severe specific effects are produced by free doses, including general depression, muscular tremors and weakness, giddiness, headache, failure of the heart and breathing, and cold perspiration: a condition resembling collapse. The exact mode of the action of the drug is not known, but it appears to depress the convolutions secondarily only; to lower the activity of the motor centres in the cord, and cause muscular relaxation: to **depress the respiratory centre**, and **relax the bronchial muscles**; and to diminish the force of the heart and the tension of the vessels, after brief increase of the latter. Lobelia kills through the respiratory centre, like its ally, tobacco, and not through the heart.

Lobelia is a favourite remedy with some practitioners for the paroxysm of asthma, for which it should be given at the commencement in doses of 1 drachm of the Tincture, repeated every fifteen minutes till nausea is produced. In 10 min. doses it is a useful addition to expectorant mixtures for bronchitis with spasm and very scanty tough sputum.

3. REMOTE LOCAL ACTION AND USES.

Lobelina is probably excreted by the kidneys and skin, and acts as a diuretic and diaphoretic. Except indirectly, these effects are not taken advantage of in medicine.

ERICACEÆ.

Uvæ Ursi Folia — BEARBERRY LEAVES.—The dried leaves of Arctostaphylos Uva Ursi. From indigenous plants.

Characters.—Obovate, entire, coriaceous shining leaves, about three-fourths of an inch in length, reticulated beneath; with a strong astringent taste, and a feeble hay-like odour when powdered; the infusion giving a bluish-black precipitate with perchloride of iron.

Composition.—Uva ursi contains an inert crystalline glucoside, *arbutin*, $C_{12}H_{16}O_7$, yielding in the urine benzoic acid; an amorphous bitter glucoside, *ericolin*, $C_{34}H_{56}O_{21}$; *tannic* and *gallic acids*; and a neutral body, *ursone*.

Incompatibles.—Iron salts, lead salts, nitrate of silver, vegetable alkaloids, gelatine.

Impurities.—Leaves of red whortleberry; detected by being dotted and not reticulated on the under surface, with crenated margins. Also box leaves, which are not astringent.

Preparation.

Infusum Uvæ Ursi.—1 in 20. *Dose*, 1 to 2 fl.oz.

ACTION AND USES.

Uva ursi possesses much the same action as Pareira and Buchu, but is more astringent in virtue of the tannic and gallic acids which it contains. The arbutin appears in the urine partly as benzoic acid. Uva ursi is used as a remote **astringent and stimulant** in diseases **of the urino-genital tract**, such as chronic catarrh of the pelvis of the kidney, bladder, and urethra.

SAPOTACEÆ.

Guttapercha — GUTTAPERCHA. — The concrete juice of Isonandra gutta. A native of Borneo, Sumatra, and other Eastern islands.

Characters and Tests.—In tough flexible pieces, of a light brown or chocolate colour. Soluble or nearly soluble in chloroform, yielding a more or less turbid solution.

Stimulant & astringent &
Genito-urinary Tract.

S.t.a.b.

Composition.—Guttapercha contains 80 per cent. of a hydrocarbon *gutta*, salts, volatile oil, fat, colouring matter, and two bodies named *alban* and *fluavil*.

Preparation.

Liquor Guttapercha.—1 in 8 of Chloroform, with 1 of Carbonate of Lead; by solution and decantation.

USES.

Guttapercha is employed for making surgical instruments and apparatus. The solution is used in Charta Sinapis.

STYRACACEÆ.

Benzoinum—Benzoin.—A balsamic resin obtained from Styrax Benzoin. It is procured by making incisions into the bark of the tree, and allowing the liquid that exudes to concrete by exposure to the air. Imported from Siam and Sumatra.

Characters.—In lumps, consisting of agglutinated tears, or of a brownish mottled mass with or without white tears imbedded in it; has little taste, but an agreeable odour; gives off, when heated, fumes of benzoic acid; is soluble in rectified spirit and in solution of potash.

Substances resembling Benzoin: Gum resins, and resins distinguished by odour and taste.

Composition.—Benzoin consists chiefly of four different *resins*, imperfectly known, with the officinal *benzoic acid*, *cinnamic acid*, and a trace of *volatile oil*.

Preparations.

1. Adeps Benzoatus.—10 gr. to 1 oz.
2. Tinctura Benzoini Composita.—"Friar's Balsam." Benzoin, 8; Prepared Storax, 6; Balsam of Tolu, 2; Socotrine Aloes, about 1½; Spirit, 80. *Dose*, ½ to 1 fl.dr.

From Benzoinum is made:

Acidum Benzoicum. Benzoic Acid. $HC_7H_5O_2$. *Source.*—Prepared from Benzoin by sublimation. *Characters.*—Light feathery crystals, nearly colourless, having an aromatic odour. Soluble in 400 of cold water, in 12 of boiling water, in 4 of spirit. Phosphate of soda or borax aids its solubility in water, so that 1 of borax and 1 of acid are soluble in 100 of water. *Dose*, 10 to 15 gr.

From Acidum Benzoicum are prepared :
a. Tinctura Camphoræ Composita.—2 gr. to 1 fl.oz.
b. Tinctura Opii Ammoniata.—9 gr. to 1 fl.oz. See *Opium*.

From Acidum Benzoicum is made :

Ammoniæ Benzoas.—$NH_4C_7H_5O_2$. Colourless laminar crystals with the fragrant odour of benzoic acid, made by dissolving benzoic acid in solution of ammonia and water, evaporating and crystallising. Soluble in 5 of water; in 18 of rectified spirit. Sublimes without residue. *Incompatibles.*—Persalts of iron, liquor potassæ, and acids. *Dose*, 10 to 20 gr.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally.—Benzoin and its preparations are **antiseptic** and **disinfectant**, and at the same time slightly **stimulant** to the vessels. The compound tincture, or "Friar's Balsam," has been long used as an application to ulcers and foul wounds, and also to promote the healing of freshly incised wounds.

Internally.—Benzoin and its acid cause sneezing and coughing when inhaled or applied in the solid form to the nose; much diluted with watery vapour, they are mild stimulants. The compound tincture is thus a useful substance for inhalation or spray in many laryngeal diseases; and benzoic acid has been applied direct to the affected surface in diphtheria, where it acts also as a disinfectant.

Taken by the mouth, benzoic acid causes slight heat and irritation in the region of the stomach; the ammonia salt is much less irritant, and can be given in larger doses.

2. ACTION IN THE BLOOD AND USES.

Benzoin and benzoic acid enter the blood in the form of benzoate of sodium, and here, as well as in the kidneys, this acid is partly **converted into hippuric acid** by combination with a molecule of glycocoll, thus:—$C_7H_6O_2 + C_2H_5NO_2$ (glycocoll) $= C_9H_9NO_3$ (hippuric acid) $+ H_2O$. The exact source of the glycocoll is still obscure. It is *not* derived from the urea or uric acid, as was once suggested; and the use of benzoic acid to take up and carry out by the urine excess of urea in uræmia, or excess of uric acid in gout, is erroneous in theory, as it has failed in practice.

Antiseptic + D is infectant
Antipyretic
Increases tissue Metabolism
Accelulates the Urine.
Stimulates + disinfects Mucous
Membranes.
Is converted into Hippuric Ac

3. SPECIFIC ACTION AND USES.

Benzoic acid and its salts act upon nutrition very much like the salicylates, as far as they have been investigated; that is, they are **antipyretic**, whilst they are said to **increase metabolism.** They have been used to lower the temperature in pyæmia, acute rheumatism, and specific fevers; but their effects are very uncertain, and frequently very unpleasant. Their internal use in phthisis has quite failed, and in diphtheria they are of doubtful value.

4. REMOTE LOCAL ACTION AND USES.

Benzoic acid is excreted by the kidneys, partly unchanged, partly as hippuric acid, and occasionally as succinic acid, increasing the flow of urine; by the skin and salivary glands, unchanged, stimulating their secretions; and probably by the respiratory organs, decidedly increasing the amount of expectoration. These remote local effects are turned to useful account. The acid and its ammonia salt are extremely valuable in inflammation of the bladder with alkalinity of the secretion and phosphatic deposits, by **acidulating the urine and stimulating and disinfecting the mucous surfaces**; and they are used all the more that they are almost the only certain means of neutralising morbid alkalinity of the urine which we possess. As an expectorant, benzoic acid, chiefly as the compound tincture, or contained in Tinctura Camphoræ Composita, Tinctura Opii Ammoniata, and the balsams of Tolu and Peru, is very useful in chronic bronchitis, when the bronchial products are abundant, thick, possibly foul, the mucous membrane chronically inflamed and weak, and reflex activity low.

OLEACEÆ.

Olivæ Oleum—OLIVE OIL.—The oil expressed in the south of Europe from the ripe fruit of Olea europæa.

Characters.—Pale yellow, with scarcely any odour, and a bland oleaginous taste; congeals partially at about 36°.

Composition.—Olive oil consists of 72 per cent. of a fluid oil, *olein*, and 28 per cent. of a solid oil or stearoptene, *palmitin*. These are compounds of a base, *glyceryl* (C_3H_5), with *oleic acid* ($C_{19}H_{34}O_2$), and *palmitic acid* ($C_{17}H_{31}O_2$) respectively.

Dose, ½ to 1 fl.oz.

Preparations.

Many Plasters, Liniments, Ointments, Enema Magnesiæ Sulphatis, Charta Epispastica, and Cataplasma Lini. It is also the source of the Soaps and Glycerine.

Sapo Durus.—Hard Soap. Made with Olive Oil and Soda.

Preparations.

a. Emplastrum Cerati Saponis.
b. Emplastrum Saponis.—1 in 7½.
c. Linimentum Potassii Iodidi cum Sapone.—See *Iodum.*
d. Linimentum Saponis.—1 in 10.
Contained in Linimentum Opii.
e. Pilula Saponis Composita.—Opium, ½ oz.; Hard Soap, 2 oz.; Water, q.s. See *Opium.*

Hard Soap is also used in the preparation of many pills, several plasters, and Extractum Colocynthidis Compositum.

Sapo Mollis.—Soft Soap. Made with Olive Oil and Potash.
Sapo Mollis is contained in Linimentum Terebinthinæ.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally applied, olive oil renders the skin smoother softer, and more flexible. It is used to facilitate friction over enlarged bones, or stiff joints; and in the form of liniments, to bring active bodies, such as ammonia and lime, more thoroughly into contact with the surface in a mild form. It is also an excellent **mechanical application** to burns and certain skin diseases, by coating the surface and excluding air, and in the treatment of the effects of corrosive acids and alkalies. Inunctions with olive oil to which $\frac{1}{10}$th part of carbolic acid has been added, should be ordered in the desquamative stage of scarlet fever, as a disinfectant measure. Oil rubbed into the skin is absorbed by the lymphatics, and has a distinctly **nutritive** effect, of which use may be made in wasted children when the stomach rejects food.

Internally, oils may be similarly given in corrosive poisoning. In the stomach they are not specially changed; in the intestines they are partly emulsified, partly saponified, their glycerine being set free, and their fatty acid combining with free alkalies to form soaps. The molecular basis of the chyle is thus increased by this emulsion and soapy compound. In many persons excess of oil causes dyspepsia and loathing, especially in warm weather; and in most subjects some relaxation of the bowels or diarrhœa. As an Enema, olive oil is **laxative**, and is used in obstruction of the bowels.

Nutrition.
Laxative

2. ACTION IN THE BLOOD, SPECIFIC ACTION AND USES.

Olive oil enters the blood from the lacteals or lymphatics, and may be traced in it if given in excess. Thence it enters all the cells of the body, especially those of the connective tissues, the amount varying with a number of circumstances. Here it is fully oxydised into carbonic acid and water, and constitutes one of the kinds of food, increasing the amount of fat in the tissues, furnishing force, and thus saving the waste of nitrogenous tissue and the necessity of consuming quantities of nitrogenous food, but unable of itself to support life.

Oils and fats are used in many forms (olive and other vegetable oils, butter, cream, cod-liver oil, etc.), in wasting diseases, such as scrofula and phthisis, as is fully discussed under *Oleum Morrhuæ*, page 379. Olive oil is rarely used in this country, but may be taken by some patients, in the form of sardine oil, when cod-liver oil is rejected.

3. REMOTE LOCAL ACTION.

Oils are excreted as carbonic acid and water, but excess will appear unchanged in the urine. It is not a special renal irritant like linseed oil.

Glycerinum.—Glycerine, $C_3H_8O_3$. A sweet principle obtained from fats and fixed oils, and containing 5 per cent. of water.

Characters.—A clear colourless fluid, oily to the touch, without odour, of a sweet taste, a free solvent of many substances. Sp. gr., 1·250. *Dose*, 1 to 2 fl.dr.

Preparations.

1. Glycerinum Acidi Carbolici.—4 to 1.
2. Glycerinum Acidi Gallici.—4 to 1.
3. Glycerinum Acidi Tannici.—4 to 1.
4. Glycerinum Amyli.—8 to 1; heated to 240° Fahr., until a jelly is formed.
5. Glycerinum Boracis.—4 to 1.

Glycerine is also a constituent of:

Linimentum Potassii Iodidi cum Sapone.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally.—Glycerine is a slightly **stimulant, antiseptic, hygroscopic,** and adhesive substance, which forms a useful application to skin diseases and small sores, such as chaps, whether alone or in combination with other remedies as a lotion, instead of ointments, which become rancid. (In the pure state it is used to preserve microscopic specimens and vaccine lymph.) Glycerinum Amyli is used as a basis for ointments.

Glycerine is readily absorbed by the unbroken skin, and will carry in with it certain active substances, such as extract of belladonna. Glycerates may thus produce specific effects. It is also applied to the cervix uteri, conjunctiva, meatus auditorius, and other exposed mucous surfaces.

Internally.—Glycerine is **very sweet,** and imparts a smooth sweet agreeable taste to nauseous or astringent mixtures, rendering the addition of sugar unnecessary. As a topical stimulant and demulcent, it is an excellent vehicle for such applications for sore throat as tannic acid. In the stomach it produces no special effect; but is a mild laxative when freely given. As an enema, it has been administered in ulceration of the bowels.

2. ACTION ON THE BLOOD.

Glycerine is freely absorbed by all surfaces, and is one of the normal products of the digestion of oils and fats in the intestines. In large quantity it is said to cause the solution of the red corpuscles, the diffusion of the hæmoglobin in the plasma, and consequent hæmoglobinuria.

3. SPECIFIC ACTION AND USES.

Glycerine has been supposed to be **nutritive,** and may contribute to the formation of adipose tissue, as a portion of the fats and oils of food must be decomposed in digestion, and the glycerine again united with the fatty acid in the process of nutrition. The results obtained from the administration of glycerine instead of oils in phthisis have been very divergent, and on the whole not encouraging. The same may be said of its use in diabetes.

4. REMOTE LOCAL ACTION AND USES.

Glycerine is decomposed in the system, and passes out as propionic, formic, and other acids. The urine of persons taking glycerine contains a reducing body which gives the

Stimulant.
Antiseptic.
Hydroscopic.
Nutritive

Lavatrice

copper and fermentation-tests of sugar, but is not sugar. Hæmoglobinuria after large doses has been already referred to.

Oleic Acid, $HC_{18}H_{33}O_2$. (*Not Officinal.*)—One of the constituent acids of oil obtained by the action of superheated steam.

Characters.—A yellowish oily liquid, odourless, tasteless, neutral in reaction. Sp. gr., ·800 to ·810. Insoluble in water; soluble in alcohol, chloroform, benzol, benzin, turpentine, and fixed oils. It dissolves most metallic oxides, forming indefinite solutions of oleates in excess of oleic acid.

Non-officinal Preparations of Oleic Acid.

Oleate of Mercury; Oleate of Lead; Oleate of Zinc; and various ointments and plasters.

ACTION AND USES.

Oleic acid is much more **readily absorbed by the skin** than the fixed oils from which it is derived, and preparations made with it as the solvent or basis have a high penetrating power. The oleate of mercury is now extensively employed.

Manna—Manna.—A concrete saccharine exudation from the stem of Fraxinus Ornus, and F. rotundifolia. Obtained by making incisions in the stems of the trees, which are cultivated for the purpose, chiefly in Calabria and Sicily.

Characters.—In stalactiform pieces from one to six inches in length, and one or two inches in width, uneven, porous, and friable, curved on one side, of a yellowish-white colour, with a faintly nauseous odour, and a sweetish taste.

Composition.—Manna consists principally of about 70 per cent. of *mannite*, $C_3H_7O_3$, common sugar, and extractive matter. Mannite does not undergo vinous fermentation.

Dose.—60 gr. to 1 oz.

ACTION AND USES.

Manna is a mild **laxative**, commonly given to children for constipation, because not unpleasant and easily dissolved in milk.

LOGANIACEÆ.

Nux Vomica—Nux Vomica.—The seeds of Strychnos Nux vomica. Imported from the East Indies.

Characters.—Nearly circular and flat, about an inch in diameter, umbilicated and slightly convex on one side, externally of an ash-grey colour, thickly covered with short satiny hairs, internally translucent, tough and horny; taste intensely bitter; inodorous.

Composition.—Nux vomica seeds contain two alkaloids: ·2 to ·5 per cent. of *strychnia*, and ·12 to 1·0 per cent. of *brucia*, united with a crystalline acid, *strychnic* or *igasuric acid*, with the ordinary constituents of seeds.

Brucia, $C_{23}H_{26}N_2O_4$, occurs in colourless prisms, pearly flakes, or masses. It is soluble in alcohol; much more soluble in water, less bitter, 38 times weaker, and 3 times slower physiologically than strychnia.

Preparations of Nux Vomica.

1. **Extractum Nucis Vomicæ.**—Spirituous. 16 in 1. *Dose*, ½ to 1 gr.

2. **Tinctura Nucis Vomicæ.**—1 in 10. *Dose*, 5 to 30 min.

From Nux Vomica is made:

Strychnia. *Source.*—Made from Nux vomica by (1) adding a solution of Acetate of Lead to a concentrated tincture, so as to precipitate the colouring matter, etc.; (2) adding Ammonia to the solution, to precipitate the alkaloids; (3) dissolving out the Brucia by boiling Spirit, and crystallising out the Strychnia by evaporation and cooling; (4) purifying by repetition of process (3).

Characters.—Strychnia, $C_{21}H_{22}N_2O_2$, occurs in very small colourless prisms, inodorous, intensely bitter (but not to be tasted by the student except in very weak solutions). Solubility, 1 in 6,500 of cold, in 2,500 of boiling water.

Impurity.—Brucia, giving red with HNO_3.

Dose.—$\frac{1}{30}$ gr., gradually increased to ⅛ gr., always in solution.

Preparation of Strychnia.

Liquor Strychniæ.—4 gr. to 1 fl.oz. of Spirit, Water, and Diluted Hydrochloric Acid. *Dose*, 4 to 10 min.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION.

Externally.—Strychnia is a powerful antiseptic, but is too poisonous to be applied to wounds.

Action of Bitters.

Increases Peristaltic Action

Violent Convulsions

Motor centres of Cord irritated

Reflex excitability increased.

Respiratory Centre stimulated

Cardiac " "

Cardiac Ganglia "

Morphia - Chloral Physostig-
ma are Antidotes

Internally.—Nux vomica and strychnia possess all the properties of **bitters** as described under *Calumba* (page 181), to which the student will refer. Their use is not different from that of other bitters, excepting that whilst they are unpleasant from the intensity and persistency of their taste, and the absence of all covering flavour, they are very convenient on account of their small bulk. The Tincture of Nux Vomica is to be prescribed with alkalies, the Liquor Strychniæ with acids.

Strychnia is believed to **increase the peristaltic action** of the intestines, and is therefore combined with purgatives, especially aloes, for chronic constipation from atony of the bowel.

2. ACTION ON THE BLOOD.

Strychnia enters the blood from mucous surfaces, or when given hypodermically. Here it affects both the red corpuscles and the plasma, reducing the absorptive power of the former for oxygen, and the discharge of carbonic acid from the latter. These effects are not, however, the cause of the specific action of the drug immediately to be described.

3. SPECIFIC ACTION.

Strychnia quickly finds its way into the viscera, especially the nervous system, and is peculiar in remaining so long within them, that it is not wholly excreted for several days. Entering rapidly, and disappearing slowly, the alkaloid accumulates in the body if the dose, however small, be very frequently repeated, and is said to have a "cumulative action."

In medicinal doses, strychnia produces a **tonic** influence, as described under Calumba and Quinia, with a sense of increased strength and spirits. Therewith its specific action is soon developed, namely, increased sensibility of touch, sight, and hearing, with some disorder of the senses, such as of colour, vision, and smell. Repeated or larger doses next lead to sudden twitchings of the muscles of the limbs, a constricted feeling in the chest, and some dysphagia, with a sense of anxiety. Poisonous doses produce **violent convulsions**, and rapid death by exhaustion and asphyxia, from spasmodic arrest of the respiratory muscles. The phenomena resemble tetanus, but differ from it in the complete relaxation of the muscles between the convulsive seizures, in the great rapidity of their course, and in the comparative absence of trismus (lock-jaw).

Careful analysis resolves the phenomena of strychnia poisoning as follows, and enables us to understand its action in medicinal doses. The *convolutions* are unaffected. The **motor centres of the cord are powerfully irritated** by toxic doses, and

this in such a way that their **reflex excitability is enormously increased.** The very slightest stimulation of the skin, such as a breath of air, a loud sound, or a bright light, is sufficient to originate reflex muscular spasms. The muscles of respiration are manifestly involved in this effect, and the vigour of their action greatly increased; and this is carried so far that they remain contracted in inspiration, and give rise to asphyxia.

The *medulla* is stimulated by strychnia in all its important centres. The **respiratory centre is increased in activity,** and transmits powerful impulses downwards to the already excited cord, thus causing increased frequency and depth of the movements of the chest. The **cardiac centre and the cardiac ganglia** and nerves appear to be **stimulated** by strychnia, but the violent contractions of the voluntary muscles completely modify the direct effect of the alkaloid, which is said actually to cause slowing of the heart (in animals paralysed by curare). Death does not occur through the heart, which beats after respiratory death, and remains contracted. The *vaso-motor* centre is also increased in vigour, an effect which is heightened by the general muscular spasm, and finally by the asphyxial state of the blood; thus the arterial pressure rises enormously for a time.

The *motor nerves and muscles* are comparatively unaffected by strychnia, but its local application appears to stimulate them. Probably the same may be said of the *sensory* nerves, vision being improved by injections of strychnia in the temple. The *body temperature* naturally rises during the convulsions.

4. SPECIFIC USES.

Strychnia is indicated in paralysis, especially paralysis from disease or disorder of the cord, but is not of much real service in this class of cases. Its function in cerebral disease is mainly to sustain the activity of the spinal centres, nerves, and muscles until the higher centres are restored; but electricity has almost entirely displaced it for this purpose It appears, however, to be useful in the so-called "reflex," or "functional," paralysis of neurotic subjects, diphtheria, or anæmia; and in *peripheral* paralysis, of the fore-arm, eyes, larynx, sphincters, etc., often toxic in origin, *e.g.* due to lead, tobacco, or alcohol. For these local cases, strychnia is best given in the form of hypodermic or intra-muscular injection ($\frac{1}{15}$ gr. of sulphate of strychnia in 10 min. of distilled water). In sensory paralysis strychnia is useless, but it appears to relieve some forms of blindness (amaurosis) when applied locally, *i.e.* hypodermically in the temple. In chronic nervous disorders, such as chorea, epilepsy, neuralgia, and asthma, it is

of benefit as a bitter stomachic and tonic, an effect more generally available than the specific action of the drug.

Strychnia, as a respiratory stimulant, may be used in bronchitis, emphysema, and phthisis, to increase the vigour both of the respiratory centre and the respiratory movements. It is advantageously combined with expectorants, its tonic action being further useful. From its stimulant and tonic action on the heart and vessels, it is given with benefit in cardiac dilatation with low pressure.

Strychnia is a physiological antagonist of chloral, morphia, and physostigma, and may be given in moderate doses in poisoning by these substances, whilst all the ordinary methods of recovery are persevered in.

5. REMOTE LOCAL ACTION.

Strychnia is excreted in the urine, sweat, and saliva, as we have seen, very slowly. The practical importance of this fact has already been insisted on.

Spigeliæ Radix—CAROLINA PINK. (*Not Officinal.*)—The rhizome and rootlets of Spigelia marilandica. From the United States.

Characters.—A thick globular brown head, with numerous fine branching rootlets.

Composition.—Spigelia contains an uncrystallisable *bitter principle*, a *volatile oil*, *tannin*, etc.

Dose.—60 to 120 gr.

Non-officinal Preparation.

A Fluid Extract. *Dose*, 1 to 4 fl.dr.

ACTION AND USES.

Spigelia is an **anthelmintic**, and is directed against the round worm. It is moderately **purgative**, but should be assisted by senna or other cathartic.

Gelsemii Radix. (*Not Officinal.*)—The fresh rhizome and rootlets of Gelsemium sempervirens, the Yellow Jasmine. From the United States.

Characters.—A very light, fibrous, dirty-yellowish root, with rootlets; odour aromatic and heavy; taste bitterish.

Composition.—Gelsemium contains a powerful alkaloid,

gelsemin, *gelsemic acid*, a *volatile oil*, and other ingredients. *Gelsemin* is a colourless, amorphous, odourless, bitter solid, forming salts with acids.

Dose of gelsemin, $\frac{1}{60}$ to $\frac{1}{20}$ gr.

ACTION AND USES.

Gelsemium is a **powerful depressant** of the motor parts of the cord, causing paralysis, which is followed later by sensory depression and anæsthesia. Respiration fails, and death occurs by asphyxia. The heart is also depressed; the skin is stimulated. The pupil is dilated, and the ocular and levator palpebræ muscles paralysed, all through the third nerve.

Gelsemium has been given in tetanus, asthma, whooping-cough, and other convulsive diseases, with uncertain results. It appears to relieve some cases of neuralgia. In sick headache it may procure great relief, if the dose be pushed.

Non-officinal Preparations.

A Fluid Extract; *Dose*, 2 to 10 min. A Tincture; *Dose*, 5 to 20 min.

APOCYNACEÆ.

Quebracho Bark. (*Not Officinal.*)—The bark of Aspidosperma Quebracho. From Chili.

Characters.—In pieces, $\frac{3}{4}$ inch thick; interior, fibrous and cinnamon-brown, with a short fracture; exterior, reddish ochre-coloured, warty; taste, bitter, slightly aromatic, unpleasant.

Composition. — Quebracho bark and wood contain an alkaloid, *aspidospermin*, $C_{22}H_{28}N_2O_2$, soluble in spirit, nearly insoluble in water. The wood contains much tannin.

Non-officinal Preparations.

Extract; Tincture (1 to 5) in doses of 5 min to 1 fl.dr.

ACTION AND USES.

Quebracho and aspidospermin **reduce the frequency of respiration**, through the centre; the heart's action through the intrinsic ganglia; the sense of dyspnœa induced by exercise; and the body temperature. The bark has been used with success in some cases of disease attended by dyspnœa, especially emphysema, but is an uncertain drug, and should be given with caution.

Paralysis 3e Nerve.
Debrisoant.
Dedation

ASCLEPIADACEÆ.

Hemidesmi Radix — HEMIDESMUS ROOT. — The dried root of Hemidesmus indicus. Imported from India.

Characters.—Yellowish-brown, cylindrical, tortuous, furrowed, and with annular cracks, having a fragrant odour, and a very agreeable flavour.

Substances resembling Hemidesmus: Sarsaparilla, Ipecacuanha, Senega. Hemidesmus is known by cracks and absence of twisting.

Composition.—The composition of hemidesmus is imperfectly known. It is believed to contain *hemidesmic acid*, a volatile crystallisable substance.

Preparation.

Syrupus Hemidesmi.—1 in 8. *Dose*, 1 to 4 fl.dr.

ACTION AND USES.

Hemidesmus is used in India as an **alterative** in lieu of sarsaparilla, and the same obscurity exists respecting the action and value of this as of the other drug. See *Sarsæ Radix*, p. 355.

GENTIANACEÆ.

Gentianæ Radix—GENTIAN ROOT.—The dried root of Gentiana lutea. Collected in the mountainous districts of central and southern Europe.

Characters.—From half an inch to one inch in thickness, several inches in length, often twisted, much wrinkled, or marked with close transverse rings; brown externally, yellow within, tough and spongy; taste at first sweetish, afterwards very bitter.

Composition.—Gentian contains ·1 per cent. of an active bitter glucoside, *gentiopicrin*, $C_{20}H_{30}O_{12}$, which is crystalline, readily soluble in water and dilute spirit, and yields, by decomposition, glucose and *gentiogenin*. It is united with an inert non-bitter body, *gentianic acid*, sugar, gum, and a trace of a *volatile oil*.

Incompatibles.—Sulphate of iron, nitrate of silver, and lead salts.

Preparations.

1. **Extractum Gentianæ.**—Aqueous. *Dose*, 5 to 10 gr.

2. **Infusum Gentianæ Compositum.**—1 in 80, with Orange and Lemon Peel. *Dose*, 1 to 2 fl.oz.
3. **Mistura Gentianæ.**—1 in 40, with Bitter-Orange Peel, Coriander, Water, and Proof Spirit. *Dose*, ½ to 1 fl.oz.
4. **Tinctura Gentianæ Composita.**—1 in 13⅓, with Bitter-Orange Peel, Cardamoms, and Proof Spirit. *Dose*, 1 to 2 fl.dr.

ACTION AND USES.

Gentian possesses the action of other **bitters**, as described under *Calumbæ Radix*. The uses made of it correspond. It is, perhaps, the most extensively used and popular of all bitters, because (1) it is agreeable, being very slightly **aromatic**; (2) its bitter is not intense, and its astringency but slight; and (3) it is more stimulant to the bowels, and more disinfectant than some bitters. A drawback to its usefulness is the liability of the sugar which it contains to ferment in simple infusions.

Chirata—Chiretta.—The entire plant, Ophelia chirata. Collected in Northern India.

Characters.—Stems about three feet long, of the thickness of a goose-quill, round, smooth, pale brown, branched; branches opposite; flowers small, numerous, panicled; the whole plant intensely bitter.

Composition.—Chiretta contains an active bitter principle, *chiratin*, combined with *ophelic acid*, as well as the ordinary constituents of plants.

Substances resembling Chiretta: Dulcamara, Lobelia, Cannabis, which have no bitter taste.

Preparations.

1. **Infusum Chiratæ.**—1 in 40. *Dose*, 1 to 2 fl.oz.
2. **Tinctura Chiratæ.**—1 in 8. *Dose*, 15 to 60 min.

ACTION AND USES.

Chiretta is an **aromatic bitter**, almost identical in its action and uses with gentian; but may be given with iron.

CONVOLVULACEÆ.

Scammoniæ Radix—Scammony Root.—The dried root of Convolvulus scammonia. From Syria and Asia Minor.

Aromatic Bitter

Infusum made with water at 120°.

Bitter

Characters.—Tap-shaped roots, sometimes three inches in diameter at the top, brown without, white within, slightly odorous, but tasteless. Ether agitated with the powder and evaporated, leaves a residue having the properties of scammony resin.

Substances resembling Scammony Root: Belladonna, which is smaller.

Scammonium—Scammony.—A gum-resin, obtained by incision from the living root of Convolvulus scammonia, chiefly in Asia Minor.

Characters and tests.—Ash-grey, and rough externally; fresh fracture resinous, splintery, shining, black when dry; odour and flavour cheesy; causes, when chewed, a slight prickly sensation in the back of the throat; easily triturated into a dirty-grey powder, and converted with water into a smooth emulsion.

Impurities.—Chalk, detected by effervescence with acids; starch, by iodine test.

Composition.—Scammony consists of 77 to 83 per cent. of resin, soluble gum 6 to 8, and a little moisture. The root, the gum-resin, and the resin contain an active principle, *jalapin*, probably identical with the convolvulin of jalap.

Dose, 5 to 10 gr.

Scammoniæ Resina—Resin of Scammony.

Source.—Made from Scammony, or Scammony Root, by preparing a tincture, and precipitating this in water.

Characters.—Brown, translucent pieces, brittle, fragrant; entirely soluble in ether.

Impurity.—Guaiacum resin, detected by giving blue with potato.

Dose.—3 to 8 gr.

Preparations.

A. *Of Scammonium:*

1. **Confectio Scammonii.**—1 in 3, with Ginger, Oil of Caraway, Oil of Cloves, Syrup, and Honey. *Dose*, 10 to 30 gr.
2. **Pulvis Scammonii Compositus.**—Scammony, 4; Jalap, 3; Ginger, 1. *Dose*, 10 to 20 gr.

Scammonium is also an important ingredient of Pilula Colocynthidis Composita (1 in 3), and of Pilula Colocynthidis et Hyoscyami (1 in 4½).

B. *Of Scammoniæ Resina :*

1. **Mistura Scammonii.**—1 in 240 of fresh milk. *Dose*, ½ to 2 fl.oz. for a child.
2. **Pilula Scammonii Composita.**—Resin of Scammony, 1; Resin of Jalap, 1; Curd Soap, 1; Strong Tincture of Ginger, 1; Spirit, 2. This is the only aperient pill in the Pharmacopœia which does not contain aloes. *Dose*, 5 to 15 gr.

Resina Scammoniæ is also an important ingredient of Extractum Colocynthidis Compositum (1 in 7).

ACTION AND USES.

Preparations of scammony are powerful **stimulants of the intestinal glands, and** to a less degree of the **liver,** causing free purgation within a few hours, attended by griping. It begins to act in the duodenum on meeting the bile, and will not purge if injected into the blood.

Scammony is used chiefly as a smart **purgative and anthelmintic** in children, in cases unattended by irritation of the stomach and bowels. As a hydragogue, jalap is generally preferred.

Jalapa.—Jalap.—The dried tubercles of Exogonium purga. Imported from Mexico.

Characters.—Varying from the size of a nut to that of an orange, ovoid, the larger tubercles frequently incised, covered with a thin brown wrinkled cuticle; presenting, when cut, a yellowish-grey colour, with dark brown concentric circles.

Composition.—Jalap contains 15 to 20 per cent. of the officinal *resin*, which in turn is composed in part of *convolvulin*, $C_{31}H_{50}O_{16}$, a colourless, tasteless, odourless body, of gummy appearance. This is the anhydride of *convolvulinic acid*, into which it can be converted by alkalies. Convolvulin is probably identical with the jalapin of scammony.

Dose.—10 to 30 gr.

Jalapæ Resina.—Resin of Jalap.

Source.—Made by precipitating a tincture of jalap in water.

Characters.—Dark-brown opaque fragments, translucent at the edges; brittle, with a resinous fracture; with a sweetish acrid taste; readily soluble in spirit, insoluble in water.

Stimulates Intestinal Glands
Purgative.
Anthelmintic

Stimulates Intestinal Glands
Purgative
Anthelmintic.

Substance resembling Resin of Jalap : Aloes, which is bitter. *Dose*, 2 to 5 gr.

Preparations of Jalapa :

1. Extractum Jalapæ.—Spirituous and aqueous. 2 in 1. *Dose*, 5 to 15 gr.
2. Pulvis Jalapæ Compositus.—Jalap, 5; Acid Tartrate of Potash, 9; Ginger, 1. *Dose*, 20 to 60 gr.
3. Tinctura Jalapæ.—1 in 8. *Dose*, ½ to 2 fl.dr.

Jalap is also an important ingredient of Pulvis Scammonii Compositus.—3 in 8.

Jalapæ Resina is contained in Pilula Scammonii Composita.

ACTION AND USES.

The action of jalap closely resembles that of scammony, but it is less irritant or likely to gripe. Like it, jalap does not purge unless in the presence of the duodenal fluids; it is also a powerful **stimulant of the intestinal secretion**, less so of the bile. Small doses produce a laxative effect; large doses act within two hours, causing several watery stools, and some pain, unless combined with carminatives.

Jalap is extensively used in the form of the Compound Powder, as a **hydragogue** purgative to drain off water by the bowel in dropsy, and occasionally as an ordinary smart purgative. The resin in small doses may be used in laxative pills for habitual constipation. As an **anthelmintic**, jalap occurs in Pulvis Scammonii Compositus. This drug must be avoided when the alimentary canal is inflamed or irritable.

SOLANACEÆ.

Dulcamara—DULCAMARA.—The dried young branches of Solanum dulcamara, Bittersweet. From indigenous plants which have shed their leaves.

Characters.—Light, hollow, cylindrical, about the thickness of a goose-quill, bitter and subsequently sweetish to the taste.

Substance resembling Dulcamara : Chiretta, which has flowers, and is bitter.

Composition.—Dulcamara contains an alkaloid, *solanin*, $C_{43}H_{69}NO_{16}$, acting as a glucoside, and breaking up with weak acids into glucose and *solanidin*, $C_{25}H_{39}NO$, which can be further decomposed into two other alkaloids, *solanicin*, and modified *solanidin*.

Preparation.

Infusum Dulcamaræ.—1 in 10. *Dose*, 1 to 2 fl.oz.

ACTION AND USES.

Dulcamara is a gastro-intestinal stimulant, and in large doses causes vomiting. Its specific action is imperfectly understood, but it appears to cause paralysis by depression of the central nervous system, and to lower the activity of the heart, and especially of the respiration. It has been used as a diuretic and diaphoretic, but probably possesses no such action. It is very seldom prescribed.

Capsici Fructus.—Capsicum Fruit.—The dried ripe fruit of Capsicum fastigiatum. Imported from Zanzibar, and distinguished in commerce as Guinea Pepper and Pod Pepper.

Characters.—Pod membranous, from five to eight lines long, two lines broad, straight, conical, pointed, smooth, shining, but somewhat corrugated, orange red, intensely hot in taste.

Composition.—The active principle of capsicum is still uncertain. Various bodies have been separated, and named *capsicin*, *capsicol*, etc.

Impurities.—Red lead and other coloured substances.

Dose.—$\frac{1}{2}$ to 1 gr.

Preparation.

Tinctura Capsici.—1 in 27. *Dose*, 2 to 10 min.

ACTION AND USES.

Capsicum has a comparatively powerful local action, closely resembling that of volatile oils. It is used as a condiment (cayenne pepper); and medicinally in stimulant gargles, and as a stomachic, carminative, and stimulant, to dispel flatulence and rouse the appetite, especially in alcoholic subjects.

ATROPACEÆ.

Belladonnæ Folia.—Belladonna Leaves.—The fresh leaves, with the branches to which they are attached, of Deadly Nightshade, Atropa Belladonna; also the leaves separated from the branches and carefully dried; gathered from wild or cultivated British plants when the fruit has begun to form.

Characters.—Leaves alternate, three to six inches long, ovate, acute, entire, smooth, the uppermost in pairs and unequal.

Depresses Central Nervous System
" Heart's action
" Respiratory action.

Condiment.
Carminative.
Stomachic.

The expressed juice, or an infusion, dropped into the eye, dilates the pupil.

Substances resembling Belladonna Leaves: Stramonium leaves, more wrinkled; Hyoscyamus leaves, which are hairy.

Belladonnæ Radix.—BELLADONNA ROOT.—The dried root of Atropa belladonna. Cultivated in Britain or imported from Germany.

Characters.—From one to two feet long, and from half an inch to two inches thick, branched and wrinkled, brownish-white. An infusion dropped into the eye dilates the pupil.

Composition.—Besides the ordinary constituents of plants, belladonna root and leaves contain two alkaloids: (1) *atropia*, and (2) *belladonnin*, *homologous* with atropia, and *identical* with hyoscyamia, daturia, and duboisia. These alkaloids exist as malates in the plant.

Preparations.

A. *Of Belladonnæ Folia:*

1. **Extractum Belladonnæ.**—A green extract. 100 of the *fresh* leaves in 4. *Dose*, ½ to 2 gr.

From the Extract are prepared:

a. Emplastrum Belladonnæ.

b. Unguentum Belladonnæ.—80 gr. to 1 oz. of Lard.

2. **Succus Belladonnæ.**—*Fresh* juice, 3; Spirit, 1. *Dose*, 5 to 15 min.

3. **Tinctura Belladonnæ.**—1 of *dried* leaves in 20. *Dose*, 5 to 30 min.

B. *Of Belladonnæ Radix:*

Linimentum Belladonnæ.—1 oz. to 1 fl.oz. Spirit, with Camphor.

From Belladonna Root is made:

Atropia.—Atropia, Atropin, $C_{17}H_{23}NO_3$. — An alkaloid obtained from Belladonna Root.

Source.—Made by the following process: (1) Exhausting the root with Spirit; (2) precipitating the colouring matters with Lime, and filtering, and neutralising excess of Lime with Sulphuric Acid; (3) distilling off Alcohol, substituting Water, and thus precipitating (*a*) the resins and (*b*) the Atropia; (4) removing the Atropia by solution in Chloroform, distilling off the latter, dissolving in Spirit, purifying with Charcoal, and crystallising.

Characters.—Colourless, or white acicular crystals. Sparingly soluble in water, more freely in alcohol and ether. Readily decomposed in solution. Alkaline, readily forming crystallisable salts with acids. It can be chemically resolved into *tropin* and *tropic acid;* and reconstructed by the synthesis of these bodies. One of the products of tropin, called *homatropin*, has been used as a mydriatic instead of atropia. The intimate cause of the isomerism but non-identity of atropia with the other alkaloids of the atropaceæ has yet to be discovered.

Incompatibles.—Caustic alkalies decompose it; *e.g.* Liquor Potassæ (often prescribed with belladonna) renders it inert. Opium, physostigma, and strychnia are in various respects and degrees physiological antagonists. See *Opium*, pages 192 to 197.

Preparations.

a. **Liquor Atropiæ.**—4 gr. to 1 fl.oz. of Water and Spirit. Not given internally.

b. **Unguentum Atropiæ.**—8 gr. in 1 oz.

From Atropia is made:

Atropiæ Sulphas.—Sulphate of Atropia. *Source.*—Made by dissolving Atropia in Diluted Sulphuric Acid and Water, and evaporating. *Characters.*—A colourless powder, very soluble in water and in spirit; neutral. *Dose,* $\frac{1}{120}$ to $\frac{1}{60}$ gr., but not given internally as such.

From Atropiæ Sulphas is prepared:

a. Liquor Atropiæ Sulphatis.—4 gr. to 1 fl.oz. of Distilled Water. *Dose,* 1 to 2 min., by the mouth; or 2 to 5 min. of a mixture of equal parts of the Liquor and distilled water, hypodermically.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally.—Belladonna and atropia, as such or in aqueous suspension or solution, are not absorbed by the unbroken skin, but alcohol, chloroform, camphor, and glycerine, with which they are generally combined, readily convey the atropia through the epidermis. Exposed mucous membranes and inflamed areas of skin still more readily absorb atropia.

Belladonna depresses the sensory nerve endings, thus acting as a **local anæsthetic and anodyne**; the blood-vessels are first somewhat contracted, and then relaxed; and the motor nerve filaments to underlying muscles reduced in activity. Any other special nerve endings, with which the atropia may come in

Anaesthetic & Anodyne (locally)
Stimulates Respiratory Centre
Stimulates & then depresses the
Cardiac Ganglia & also the
Vaso-Motor Centres
Paralyses 3rd Nerve,
" Chorda Tympani & Sub
Maxillary Gland,

Sweat & Lacteal Nerves are
Paralysed.
Paralyses the branches of the
Vagus to the Heart & Bronchial
walls & the afferent fibres
coming from the Lungs.
Inhibitory branches of the
Bronchus are paralysed.
Diuretic.

contact, are similarly depressed, *e.g.* the nerves of the sweat and mammary glands.

Belladonna is used locally as liniment, plaster, ointment, and atropia more rarely in ointment, to relieve the pain and spasm of muscular rheumatism and neuralgia (less useful); as an anodyne and antiphlogistic in acute gout, boils, erysipelas, and other superficial inflammations—in all of which Glycerine of Belladonna (equal parts of the extract and glycerine), freely smeared on, is of great service; and in prurigo and other skin diseases to relieve itching.

Internally.—The action of belladonna on the mouth is not a local but specific one, to be presently described. In the stomach it produces a slightly anodyne effect, and has been used to relieve some forms of gastralgia and sickness. Its action on the bowels is also specific, as will be seen.

2. Action in the Blood.

Atropia very rapidly enters the blood as such, and leaves it for the tissues. As far as is known, it does not alter the corpuscles.

3. Specific Action.

Atropia reaches the organs with remarkable rapidity, and sets up a train of characteristic phenomena. After moderate doses of an active preparation of belladonna, patients almost invariably complain of dryness in the throat, with difficulty of swallowing; the pupils are found to be dilated, the vision confused; the balance and gait uncertain; the bowels possibly relaxed; the pulse reduced in frequency; the conjunctiva and even the face flushed. Larger doses aggravate these phenomena, but the pulse now becomes frequent instead of the reverse; restlessness or even convulsions may occur; and the patient becomes delirious. These symptoms occasionally follow the incautious application of belladonna to wounds or erupted areas of skin.

Physiological analysis of these phenomena yields the following results:

Convolutions.—The **delirium** caused by belladonna is rarely seen after medicinal doses. It is followed by dulness, somnolence, and insensibility, all evidences of cerebral depression.

Spinal cord.—Belladonna acts by no means powerfully on the cord, beyond slightly increasing and afterwards diminishing its reflex irritability.

Medulla.—The three great vital centres in the cord are markedly affected. The **respiratory centre is powerfully stimulated** by belladonna, so that the movements of the chest

become more frequent and more deep. This effect is independent of the blood pressure. Poisonous doses paralyse the same centre. The **cardiac centre is for a time stimulated** and the heart slowed. This is but a small part of the effect on the heart, as will be immediately seen. The **vaso-motor centre is first stimulated and then depressed** by belladonna: that is, the systemic arteries are contracted and the blood pressure raised for a time; afterwards the vessels relaxed, and the pressure lowered, causing the flushing of the skin. The irritability of the *motor nerves* is diminished, but not lost, except after large doses. The *voluntary muscles* remain unaffected. The *sensory nerves*, which, as we have seen, are locally depressed, are also depressed specifically. Thus pain is prevented or relieved.

Special efferent nerve terminations.—A markedly depressing action is exerted by belladonna upon the terminations of certain special motor or secretory nerves in connection with the viscera, or upon the "terminal apparatus" between these fibrils and the active protoplasm.

The **endings of the third nerve are paralysed** in the sphincter of the pupil and in the ciliary muscle, giving rise to the **dilatation of the pupil and the disturbance of accommodation.** The effect on the pupil is purely local in its cause; the muscle itself is also unaffected; possibly the sympathetic is somewhat stimulated. The amount of confusion of vision produced by the paralysis of accommodation will depend on the normal refraction of the patient's eye, long-sighted persons suffering most. The intra-ocular pressure is not diminished, as is often stated; it is increased by large doses.

The **terminations of the chorda tympani** in the *submaxillary gland* **are paralysed** by atropia, the result being arrest of saliva, and the dryness of the mouth and throat already mentioned. The sympathetic remains unaffected, so that the vessels in the gland dilate as usual under stimulation, and the "sympathetic secretion" can be obtained as before. Probably the mucous glands of the mouth are paralysed by atropia at the same time.

The **ends of the sudoriparous nerves** in the *sweat* glands **are depressed** by atropia, which is the most powerful of all anhidrotics. Therewith the skin is flushed, as we saw—overspread sometimes by a scarlatinoid redness or rash; and the temperature rises at first, but afterwards falls.

The **lacteal nerve terminations are paralysed,** and the secretion of milk (if present) arrested.

The **ends of the vagus** (inhibitory apparatus) in the *heart* may be **briefly stimulated** by atropia, thus increasing its

slowing action on the cardiac centre in the medulla, already seen; but they are **quickly paralysed**, the pulse rising in frequency to twice its previous rate after full doses; and this frequency cannot be reduced by faradising the vagus. Therewith the force of the systole is *not reduced after moderate doses*. Very large (poisonous) doses depress the ganglia, and finally even the muscle, and death occurs through cardiac failure, with the ventricle in diastole. The depressor and the accelerator filaments are not affected.

It will be convenient to complete here the account of the action of belladonna on the circulation. The vaso-motor stimulation noted under the medulla, coincides with the cardiac acceleration, and thus the blood pressure is decidedly raised, the heart emptying itself more frequently into tense vessels. Large doses, however, depress the vaso-motor centre; the peripheral vessels relax; the **pressure falls**; and if this be extreme, it coincides with the paralysis of the cardiac ganglia and muscle, and contributes to the final arrest of the circulation.

The **terminations of the vagus in the bronchial walls are paralysed** by atropia, the tension of the muscular coat of the bronchi diminished, and the air current thus facilitated. The **afferent branches of the vagus in the same parts are also paralysed**, thus diminishing sensibility and reflex action, that is, dyspnœa and cough. These effects are in addition to the stimulation of the respiratory centre already noticed.

The **inhibitory branches of the splanchnics** in the *intestinal* walls **are depressed** by atropia, which thus **increases the peristaltic movements**, and causes relaxation of the bowels. It is doubtful whether the ganglia and plexuses, and the muscular coat, are also affected. The vaso-motor fibres of the splanchnics, however, resist atropia.

Atropia appears to affect the terminations of the nerves of the *urethra*, *bladder*, and *vesiculæ seminales*, but this part of its action is still obscure. Frequent desire and inability to pass water is a symptom of overdoses.

Metabolism and temperature.—Nutritive activity is increased by belladonna, obviously through the increased circulation and respiration; and most of the solid excretions are increased, as will be seen under the urine. The temperature is correspondingly raised; but sinks with the failure of the circulation after large doses.

4. SPECIFIC USES.

From its sedative effect on the *convolutions*, belladonna in full doses has been given in the low delirium of fevers,

mania, and alcoholism, especially if opium fail. Neither for this purpose nor as a hypnotic can it be said to be in general use. It has also been recommended in such neuroses as epilepsy, chorea, and megrim; and in some cases relieves the symptoms of these, without effecting a cure.

Belladonna has been given with success in many forms of cord disease, including spasmodic paralysis.

Liquor Atropiæ Sulphatis is extensively instilled into the *eye* as a mydriatic or pupil dilator, for ophthalmoscopic examination, and to prevent or break down adhesions in iritis; also to paralyse accommodation before determining refraction. The routine employment of atropia in all kinds of eye disease is, however, to be deprecated, as it may sometimes precipitate glaucoma. See *Physostigma*, page 228.

Atropia occasionally relieves the *salivation* of mercury, of pregnancy, and of cerebral disease, but is necessarily uncertain, as the pathology of such cases is often obscure.

Belladonna and atropia are greatly used as *anhidrotics* to check the sweats of phthisis, and other hectic conditions. The extract is generally used in pill at bedtime, or the Solution of Sulphate of Atropia when the case can be watched.

Applied in the form of plaster, liniment, or ointment of belladonna, or as a lotion of atropia, this drug is constantly employed as an *anti-galactagogue*, to "dispel the milk" at any period after delivery. It also arrests mammary abscess.

Belladonna is a valuable remedy in some cases of disease of the *heart and vessels*, where the indication is to empty the left ventricle quickly, and relax the vessels, without diminishing the cardiac force. Such cases cannot be further particularised here, but it may be said that belladonna is frequently given, either alone or combined with digitalis, thus securing certain advantages of both drugs, whilst otherwise they may antagonise each other. Belladonna is clinically believed to relieve cardiac pain and palpitation, and is always to be preferred to opium for this purpose; probably this effect is chiefly an indirect one, referable to frequent emptying of the ventricles, lowering of the vascular tension, and prevention of distension of the heart. The plaster, or the extract mixed with glycerine, applied to the præcordium, the extract internally, and atropia subcutaneously, are more trustworthy forms for this purpose than the tincture. A combination of morphia and atropia subcutaneously is especially valuable in cardiac distress. See *Opium: Combinations of Morphia and Atropia*, page 197.

Belladonna is used in diseases of the *respiratory organs*, both for the prevention and for the relief of spasm of the bronchi (asthma), spasmodic cough of any kind, and especially

pertussis. It is difficult to over-estimate the value of this drug as a sedative to the respiratory nerves, as compared with opium. The latter also relieves spasm and cough, but tends to paralyse the respiratory centre, and has generally to be avoided. Belladonna soothes the afferent and efferent nerves of the bronchi, but strengthens the respiratory centre, and may be given with great confidence.

Some forms of chronic *constipation* are relieved by belladonna, which is here given as the extract combined usually with aloes. Acute obstruction of the bowels may yield to atropia, with or without morphia. Fissure of the anus and spasm of the sphincter are greatly benefited by its local use as a suppository.

Belladonna is useful in diseases of the *genito-urinary organs*, such as chordee, spermatorrhœa, some cases of retention of urine, the nocturnal incontinence of children, and all forms of painful spasm of the bladder, as in calculus, cystitis, and prostatitis. In these cases it is best given as suppository, or applied to the perinæum.

Belladonna or atropia may be used in *poisoning by opium* (see *Opium*, page 198), and by calabar bean.

5. Remote local action and uses.

Atropia is excreted unchanged in the urine, almost immediately on its administration: in 10 to 20 hours the last traces have left the body. It increases the urea, phosphates, sulphates, and water, but not the chlorides of the urine; that is, is **diuretic.** It cannot be said to be much used for this purpose. In flowing over the ureters, bladder, and urethra, it may again relieve local pain and spasm, as indicated in the last section.

Stramonii Folia—Stramonium Leaves.—The dried leaves of Datura stramonium, Thorn Apple. Collected from plants in flower, cultivated in Britain.

Characters.—Large, ovate, sinuous, deeply cut; of a heavy odour, which is strongest while they are drying, and of a mawkish faintly bitter nauseous taste.

Substances resembling Stramonium Leaves: Belladonna Leaves, less wrinkled; Hyoscyamus Leaves, hairy.

Stramonii Semina—Stramonium Seeds.—The ripe seeds of Datura stramonium.

Characters.—Brownish-black, reniform, flat, rough, in taste feebly bitter and mawkish; inodorous unless bruised, when they emit a peculiar heavy smell.

Composition.—Both leaves and seeds contain a crystalline alkaloid, *daturia*, combined with malic acid. Daturia, $C_{17}H_{23}NO_3$, is a tropate of tropin, that is, is identical with hyoscyamia, and isomeric but not identical with atropia. See *Belladonna*, page 299.

Incompatibles.—Metallic salts, and mineral acids. Daturia is decomposed by caustic alkalies like atropia.

Preparations of Stramonii Semina.

1. **Extractum Stramonii.**—Spirituous, after washing with ether. *Dose*, $\frac{1}{4}$ to $\frac{1}{2}$ gr.
2. **Tinctura Stramonii.**—1 in 8. *Dose*, 10 to 20 min.

ACTION AND USES.

Daturia has an **almost exactly similar action to atropia.** Two points of difference require to be noticed, namely, (1) that the extract of stramonium is more powerful than the extract of belladonna, and (2) that stramonium is more depressant to the nerves of the bronchi. The use of stramonium is almost confined to the treatment of spasmodic affections of the respiratory organs, such as spasmodic bronchitis and asthma. The extract in doses of $\frac{1}{8}$ gr. may be given to prevent or lessen the attacks, and the leaves may be smoked as cigarettes during the paroxysm.

Hyoscyami Folia.—Hyoscyamus Leaves.—The fresh leaves, with the branches to which they are attached, of Hyoscyamus niger; also the leaves separated from the branches and carefully dried; gathered from wild, or cultivated British, biennial plants, when about two-thirds of the flowers are expanded.

Characters.—Leaves sinuated, clammy, and hairy. The fresh herb has a strong unpleasant odour and a slightly acrid taste, which nearly disappear on drying. The fresh juice, dropped into the eye, dilates the pupil.

Substances resembling Hyoscyamus: See *Belladonna* and *Stramonii Folia.*

Composition and Incompatibles.—The active principle is *hyoscyamia*, which is identical with daturia, and isomeric with atropia. See *Stramonii Folia*, page 305, and *Belladonnæ Folia*, page 298.

Preparations.

1. **Extractum Hyoscyami.**—A green extract. 20 of the *fresh* leaves in 1. *Dose*, 3 to 6 gr.

From the Extract is prepared:

Pilula Colocynthidis et Hyoscyami, 1 in 3.

2. Succus Hyoscyami.—3 of fresh juice to 1 of Spirit. *Dose*, ½ to 1 fl.dr.

3. Tinctura Hyoscyami.—1 in 8. *Dose*, 15 to 60 min.

ACTION AND USES.

These **closely agree with the action and uses of belladonna and stramonium.** The special points to be noted in connection with hyoscyamus are as follows: 1. The pharmaceutical preparations of the plant are decidedly weaker in their action, and must be given in larger doses, than those of stramonium. 2. The secondary or calmative effect of the atropaceous plants on the convolutions is more rapid and pronounced with hyoscyamus, which is used in maniacal excitement, and as an anodyne and hypnotic to children. 3. The laxative and carminative effects on the bowel are decided, and hyoscyamus is often combined with purgative pills. 4. The remote local action on the urinary organs is more marked, so that the tincture relieves irritability of the bladder from any cause.

Duboisia (*Not Officinal*).—An alkaloid derived from an Australian plant, Duboisia myoporoides, and identical with Hyoscyamia.

Sulphate of Duboisia, in golden-yellow scales, is more powerful than the atropia salt, and may be used as a mydriatic, in the form of a solution, 1 gr. to the ounce. Stronger solutions are apt to produce general toxic effects.

Homatropin (*Not Officinal*).—A derivative of Atropia. Its action is similar to that of atropia, though weaker.

It is used only in ophthalmic practice, its advantage being, that whilst it acts as promptly though not so energetically as atropia, its effects subside in about one-fourth the time.

Tabaci Folia— LEAF TOBACCO. — The dried leaves of Virginian Tobacco, Nicotiana tabacum. Cultivated in America.

Characters. — Large mottled-brown ovate or lanceolate acuminate leaves, bearing numerous short glandular hairs;

having a peculiar heavy odour and nauseous-bitter acrid taste; yielding, when distilled with solution of potash, an alkaline fluid, which has the peculiar odour of nicotin, and precipitates with perchloride of platinum and tincture of galls. Not manufactured.

Composition.—Tobacco contains a most powerful alkaloid, *nicotin*, and a concrete volatile oil, *nicotianin*, as well as alkaline salts and other less important substances. *Nicotin*, $C_{10}H_{14}N_2$, is a colourless oily-looking fluid, with an irritating odour of tobacco, and an acrid taste. It forms salts with acids, which, like nicotin itself, are readily soluble in water.

Tobacco smoke contains the very smallest trace only of nicotin, or none, but a number of volatile bodies, chiefly *pyridin* compounds, such as *pyridin*, C_5H_5N; *picolin*, C_6H_7N; *lutidin*, C_7H_9N; *collidin*, $C_8H_{11}N$, which have somewhat the same action as nicotin, but less severe. Hydrocyanic and hydro-sulphurous acids, other simpler gases, creasote, etc., also occur in tobacco smoke.

Preparation.

Enema Tabaci.—20 gr. infused in 8 fl.oz. of Boiling Water for one enema.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Tobacco, taken by the mouth, is a **gastro-intestinal irritant**, causing salivation, nausea, vomiting, severe colic, and repeated evacuations. The same effects may follow tobacco smoking, and the application of the leaf to the unbroken skin, or of snuff to the nose. Tobacco smoking and snuffing may thus cause catarrh of the throat and stomach, and promote the movement of the bowels—facts of therapeutical interest. Tobacco is never given by the mouth. Snuff is an errhine.

Injected into the rectum, the Enema rapidly produces peristaltic movements, with expulsion of gas and fæces, and the specific effects now to be described. It has been used in ileus and constipation.

2. ACTION IN THE BLOOD.

Nicotin very rapidly enters the blood from all surfaces, but does not directly affect the corpuscles.

3. SPECIFIC ACTION AND USES.

All the organs are quickly reached by nicotin. It acts chiefly upon the **nervous structures**, which it **first stimula tes**, if

Gastro-intestinal Irritant.
Stimulates & then depresses
the Nervous System

given in very minute doses; but **afterwards depresses** in an extreme degree, causing **intense** and **universal debility**, which, with the local irritation of the alimentary canal, constitute a condition of collapse. On analysis, it is found that tobacco causes pleasing cerebral excitement; decided stimulation of the motor centres in the cord, with a feeling, and true increase, of muscular strength (ending in convulsions and paralysis, in poisonous doses); excitation, followed by paralysis, of the peripheral nerves, both sensory and motor; but no direct effect on the muscles. Respiration is first excited, then disturbed, and finally arrested, death by tobacco being due to arrest of the centre. The action of tobacco on the heart is, contrary to general belief, not directly the cause of death: it is first slowed, then accelerated, and finally weakened with slowing, but it beats after respiratory death. The blood pressure falls, rises, and falls again, with the cardiac action, and from direct central and peripheral effect on the vasor apparatus. The temperature falls.

Tobacco was formerly employed in enema to produce general muscular debility and relaxation, for the reduction of hernia; but chloroform has entirely displaced it. Its depressant effects suggest its use as an antispasmodic in whooping-cough, asthma, hiccup, tetanus and strychnia poisoning, rigidity of the cervix uteri, etc., but such a powerful drug is very seldom employed.

4. REMOTE LOCAL ACTION AND USES.

Nicotin is excreted unchanged in the urine, saliva, and fæces. As a diuretic, it was formerly given in dropsy, but this use of the drug has been abandoned.

SCROPHULARIACEÆ.

Digitalis Folia—DIGITALIS LEAVES.—The dried leaves of Digitalis purpurea, Purple Foxglove. Collected from wild indigenous plants, when about two-thirds of the flowers are expanded.

Characters.—Ovate lanceolate, shortly petiolate, rugose, downy, paler on the under-surface, crenate.

Substance resembling Digitalis Leaves: Matico, which is more deeply reticulated.

Composition.—The active principle of digitalis, known as *digitalinum*, or *digitalin*, occurs in two forms: (*a*) *Homolle* and *Quévenne's digitalin*, a yellowish-white amorphous, or scaly very intensely bitter substance; and (*b*) *Nativelle's digitalin*, in

crystalline prisms, also very bitter. It is now known to be a compound of four bodies, namely, (1) *Digitalin* proper, insoluble in water, forming the bulk of Homolle's digitalin; (2) *Digitalein*, very soluble in water; (3) *Digitoxin*, insoluble in water, and the chief constituent of Nativelle's digitalin; and (4) *Digitonin*, probably the same as saponin, the active principle of senega. Digitalein seems to possess the properties of a mixture of digitalin and digitonin. Digitoxin is by far (7 times) the most powerful, a local irritant, and a muscular depressant; and therefore, and because insoluble, unfit for use. None of the constituents are so suitable as digitalis leaf itself.

Incompatibles.—Sulphate and tincture of iron, acetate of lead, and preparations of cinchona.

Preparations.

1. **Digitalinum.** Digitalin. — A complex active substance obtained from digitalis. *Source.*—Made from (1) an alcoholic extract, by dissolving out the Digitalin with Acetic Acid and Water; (2) decolorising with Charcoal; (3) precipitating the impure Digitalin with Ammonia and Tannic Acid; (4) removing excess of Tannic Acid by Oxide of Lead; (5) dissolving in Spirit; and (6) purifying with Charcoal and Ether. *Characters.*—Porous mamillated masses, or small scales, white, inodorous, and intensely bitter. *Dose*, $\frac{1}{60}$ to $\frac{1}{30}$ gr.

2. **Infusum Digitalis.**—1 in 160. *Dose*, 2 to 4 fl.dr.

3. **Tinctura Digitalis.**—1 in 8. *Dose*, 5 to 30 min.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally, digitalis has a slightly irritant action; it is probably not absorbed by the unbroken skin.

Internally, in full doses, it deranges the stomach and bowels; dyspepsia, vomiting, and occasionally diarrhœa following its continued use in small doses—effects which are partly local, partly specific, and to be carefully avoided or checked in practice.

2. ACTION IN THE BLOOD AND SPECIFIC ACTION.

The active principles of digitalis enter the blood freely. Thence they reach the tissues more quickly than they leave them; and doses, however small, if closely repeated, tend to accumulate in the body. **The action of digitalis is mainly**

Slows & strengthens the heart.
Raises blood pressure.
Diuretic
Circulation then fails.
Death from failure of Heart.
Refrigerant.

confined to the circulatory organs, the other parts being chiefly affected secondarily. Both the heart and vessels are influenced by the drug, the action of which occupies *four stages*, the first stage being shortened and the other stages more marked as the dose is increased. In the *first stage*, the heart falls in frequency (say to fifty per minute), from stimulation of the vagus in the heart and medulla; and beats with increased force, from stimulation of the intrinsic ganglia. Therewith the arterial pressure rises, from the increased cardiac force, and from excitation both of the vaso-motor centre and vaso-motor nerves. The result of all this is that the ventricles are well filled (diminished frequency, *i.e.* lengthened diastole); the ventricles are thoroughly emptied (increased force); the arteries are thus well filled; and they are kept filled (vaso-motor action.) The condition is that of a perfect circulation, which **empties the veins and fills the arteries.**

In the *second stage*, the state of the heart remains unchanged, but the vaso-motor apparatus of the renal arteries are rather suddenly depressed; these vessels are relaxed; and the force of the circulation is thus thrown upon them, that is on the glomeruli. The result is **increase in the excretion of urinary water.**

In the *third stage*, the heart rises in frequency, from depression of the vagus, and probably some irritation of the sympathetic (accelerator) fibres; and loses force, from commencing exhaustion of the intrinsic ganglia and muscle. At the same time the arterial pressure falls, from the weakening of the heart, and from depression of the vaso-motor apparatus, which spreads from the kidney, where it commenced, to the other peripheral arterioles. Thus the **circulation begins to fail.**

In the *fourth stage*, the action of the heart becomes irregular, infrequent, and weak, from failure of the ganglia and myocardium; and is finally arrested in diastole. Therewith the blood pressure gradually sinks to zero, from loss of cardiac force and complete paralysis of the vessel walls. **Death occurs by general circulatory failure.**

Respiration fails at last, but only through the circulation. The *voluntary muscles* are paralysed through failure of their blood supply. The *uterus* is said to be stimulated by moderate doses. The *body temperature* is briefly raised through increased vigour of the circulation; it is then lowered by the increased blood-flow in the skin; and falls still more in the last stages, in an irregular uncertain way, from causes still obscure. Digitalis is thus a **refrigerant.** The *central nervous system* is only secondarily affected through the blood supply. Headache, giddiness, disturbance of sight and vision are frequently induced by

medicinal doses of digitalis; with a sense of faintness, depression, nausea, or actual sickness. *Metabolism* is variously influenced by digitalis, according to the length of the different stages and the rapidity of their development. When the pressure and temperature are high, the urea and uric acid may be increased, and certain salts may be diminished in amount.

The effect of digitalis on the *urine* is equally uncertain in the healthy individual; the period at which the renal vessels begin to be relaxed, the duration of the second stage, and the relation of the action of the drug on the heart to its action on the vessels, being all variable. As a rule, the urine is not increased in bulk in health, but is remarkably increased in some cases of dropsy to be presently referred to.

3. Specific uses.

Digitalis is one of the most valuable of medicinal remedies, and is employed in the following conditions:

1. Digitalis is indicated in **disease of the heart,** when the nervo-muscular structures of the cardiac walls fail, so that the circulatory force falls, the cavities are incompletely emptied, the arteries are insufficiently filled, the veins imperfectly drained, and the blood accumulates behind the seat of disease. Such a condition is characterised by cardiac distress and pain; a small, weak, and often irregular pulse; distension of the veins, hæmorrhage, dropsy, and visceral disorder; and often by congestion of the lungs, and great dyspnœa. It occurs under a variety of circumstances which demand separate consideration.

The disturbances of the circulation produced by disease of the *valves* of the heart are removed by a natural process of compensation, consisting of hypertrophy of the muscular walls, with or without dilatation of the cavities. If this compensation do not occur, or fail after having been established, and the circulation be disordered as described, digitalis may give relief, by increasing the force of the cardiac wall; by lengthening diastole, so that the venous flow and the ventricular rest are both prolonged; and by sustaining the pressure on the arteries, thus driving the blood in a steady stream into the veins. All the symptoms will be thus removed, including dropsy, the fluid being absorbed by the increased venous flow, and excreted by the kidneys as a profuse diuresis. Mitral disease, tricuspid incompetence, and aortic obstruction are the forms of valvular disease in which imperfect or failing hypertrophy is relieved by digitalis. In aortic incompetence some authorities forbid the use of the drug, as prolonging diastole, and thus permitting greater reflux, but this practice is not to be carried too far, and digitalis must be given if the

ventricle fail. In mild cases, when little more than a tonic effect on the heart is desired, the tincture is prescribed. When dropsy is present, and the patient confined to bed, the infusion or the powdered leaf should be given, and the effect carefully watched. Without nourishing, digestible, and digested food, digitalis can only exhaust the heart, and attention must therefore be paid to the stomach, liver, and bowels. Iron may be combined with advantage, but only after the excretory and digestive functions have been restored. Let it be carefully observed that digitalis is not to be given in a routine fashion for valvular disease, but *with reference to the state of the muscular wall associated with the lesion.* Digitalis is of great service in failure of the heart from *primary* disease of the walls, as in chronic myocarditis; in the granular degeneration of acute myocarditis, pericarditis, and endocarditis, occurring in scarlet fever and acute rheumatism; and in acute alcoholism. In fatty degeneration digitalis may have to be withheld, lest irregular contraction and rupture occur. Digitalis restores the vigour of the heart in failing hypertrophy of *chronic Bright's disease*, when it is breaking down against excessive peripheral resistance; until the heart begins to fail, the drug is contra-indicated, but when dilatation begins it must be given. In *functional* or *nervous* palpitation, pain, or irregularity, with debility and dyspepsia, digitalis is often valuable; as also in reflex cases, with gastric disorder, where small doses control the vagus, but must be given intermittently, the dyspeptic effect of the drug also being remembered. Digitalis is harmful in pure *hypertrophy.* In disease of the *right ventricle* from chronic lung disease digitalis is occasionally useful, but fails entirely in some cases. In *exophthalmic goître* it is invaluable combined with quinine and iron. In *cardiac dropsy* digitalis is a thoroughly rational and highly successful remedy. In *renal dropsy* it is of great service, when this is acute, complicating scarlet fever, or due to failure of an hypertrophied heart. In dropsy from chronic tubular nephritis (large white kidney) it is rarely of use, as it has no influence on the renal cells.

Digitalis is used in *hæmorrhage*, but therapeutics is notoriously uncertain here. It will relieve hæmoptysis due to mitral disease, or to the congestion of incipient phthisis in persons with languid circulation. For menorrhagia it may be useful by stimulating the uterine wall, or in the subjects of heart disease.

In secondary bronchial catarrh and acute pneumonia it acts entirely as a cardiac stimulant. Digitalis is but little used by English physicians as an antipyretic in fever, as it is slow, uncertain, dangerous, and unnecessary. Combined with quinia

it is exhibited in phthisis, but is apt to derange digestion. Empirically, in doses of several drachms, the tincture has been found useful in *delirium tremens*, but is unquestionably dangerous. Moderate doses are invaluable in the same disease, or in subacute or chronic cases of alcoholism, to stimulate the heart, relieve low sinking feelings, and rouse the appetite.

4. REMOTE LOCAL ACTION.

Traces of some of the active principles of digitalis have been detected in the urine. The action of the drug upon the urine, let it be carefully noted, is not due to any direct influence on the cells of the kidney, but to its effect chiefly on the heart and vessels generally, partly on the renal arteries.

LABIATÆ.

Rosmarini Oleum—Oil of Rosemary.—The oil distilled from the flowering tops of Rosmarinus officinalis.

Characters.—Colourless, with the odour of rosemary, and a warm aromatic taste.

Composition.—Oil of rosemary has the usual composition of its allies, consisting of a terpene, isomeric with turpentine, $C_{10}H_{16}$, and a body allied to camphor.

Dose.—1 to 5 min.

Preparations.

Spiritus Rosmarini.—1 in 50. *Dose*, 10 to 30 min.

Oil of Rosemary is also contained in Linimentum Saponis and Tinctura Lavandulæ Composita.

ACTION AND USES.

Rosemary resembles the other aromatic volatile oils in its action and applications. It is a favourite component of stimulating lotions.

Lavandulæ Oleum—Oil of Lavender.—The oil distilled in Britain from the flowers of Lavandula vera.

Characters.—Colourless or pale yellow, with the odour of lavender, and a hot bitter aromatic taste.

Composition.—Oil of lavender is a mixture of a terpene, $C_{10}H_{16}$, and a substance allied to camphor.

Impurities.—Oils of spike and turpentine.

Dose.—1 to 5 min.

Preparations.

1. **Spiritus Lavandulæ.**—1 in 50. *Dose*, ½ to 1 fl.dr.
2. **Tinctura Lavandulæ Composita.**—*Dose*, ½ to 2 fl.dr.

Tinctura Lavandulæ Composita is contained in Liquor Arsenicalis.

Oleum Lavandulæ is an ingredient of Linimentum Camphoræ Compositum.

ACTION AND USES.

Lavender possesses the action of aromatic volatile oils in general, and is used in the same way. The tincture is a favourite colouring material for mixtures and lotions.

Menthæ Piperitæ Oleum—Oil of Peppermint.—The oil distilled in Britain from fresh flowering Peppermint, Mentha piperita.

Characters.—Colourless or pale yellow, with the odour of peppermint; taste warm and aromatic, succeeded by a sense of coldness in the mouth.

Dose.—1 to 5 min.

Menthæ Viridis Oleum—Oil of Spearmint.—The oil distilled in Britain from fresh flowering Spearmint, Mentha viridis.

Characters.—Colourless or pale yellow, with the odour and taste of spearmint.

Dose.—1 to 4 min.

Composition.—Peppermint oil consists of a liquid terpene, and a stearoptene, *peppermint-camphor* or *menthol*, $C_{10}H_{20}O$, in colourless prisms, with the taste and odour of peppermint. Oil of spearmint has probably a similar composition.

Preparations.

A. *Of Peppermint:*

1. **Aqua Menthæ Piperitæ.**—1 in 853, by distillation. *Dose*, 1 to 2 fl.oz.
2. **Essentia Menthæ Piperitæ.**—1 in 5. *Dose*, 10 to 20 min.
3. **Spiritus Menthæ Piperitæ.**—1 in 50. *Dose*, 30 to 60 min.

Oil of Peppermint is also contained in Pilula Rhei Composita.

B. *Of Spearmint :*

Aqua Menthæ Viridis.—1 in 853, by distillation. *Dose*, 1 to 2 fl.oz.

ACTION AND USES.

Peppermint has the action of other **aromatic** volatile oils (see *Caryophyllum*, page 242), and is used accordingly. It is a favourite flavouring agent, with powerful carminative effects.

Menthol, the stearoptene of *Mentha arvensis*, and "Chinese oil of peppermint," have lately been used locally to relieve the pain of rheumatism, neuralgia, and toothache, as possessing in a marked degree the local anæsthetic, vascular stimulant, and disinfectant action of these oils, described under *Terebinthinæ Oleum*. It is of no real value as an antiseptic dressing.

Oleum Thymi—Oil of Thyme. (*Not Officinal.*)—A volatile oil distilled from Thymus vulgaris.

Thymol. — $C_{10}H_{13}HO$ (*Not Officinal*). — A stearoptene contained in Oil of Thyme.

Characters.—Large colourless, transparent crystals with an aromatic thyme-like odour, and an aromatic peppery taste. Solubility, 1 in 800 of water; freely in spirit and caustic alkaline solutions; also in fats and oils.

Dose.—$\frac{1}{2}$ to 2 gr.

Non-officinal Preparations.

Thymol Solution.—For antiseptic spray, 1 in 1000.
Thymol Gauze.—Contains 1 per cent. of thymol.
Thymol Ointments.—Contain 5 to 30 gr. in 1 oz.

ACTION AND USES.

Thymol is an **antiseptic** and **disinfectant**, extensively used in the Listerian system.

HAMAMELACEÆ.

Hamamelis. (*Not Officinal.*)—The leaves of Hamamelis virginica, the Witch Hazel, collected in autumn. From the United States.

Characters.—Short petiolate, 4 inches long, obovate or oval, oblique at base, sinuate-toothed, nearly smooth; inodorous; astringent and bitter.

d:r. a. m. fu. d.

Composition.—Hamamelis contains traces of *tannic acid*, odorous matters, etc. Its active principle appears to be unknown.

Non-officinal Preparations.

Hamamelin, a powdered Extractive; *Dose*, ½ to 2 gr. Tincture (1 to 10); *Dose*, 2 to 5 min. Fluid Extract (1 in 1); *Dose*, 10 min. to 2 fl.dr.

ACTION AND USES.

Hamamelis is an **astringent** and **hæmostatic** both locally and remotely, useful in hæmorrhages from the nose, lungs, rectum, or uterus.

POLYGONACEÆ.

Rhei Radix—Rhubarb Root.—The dried root deprived of the bark, from one or more undetermined species of Rheum. From China, Chinese Tartary, and Thibet. Imported from Shanghai and Canton.

Characters.—Trapezoidal, roundish, cylindrical, or flattish pieces, frequently bored with one hole, yellow externally, internally marbled with fine waving greyish and reddish lines, finely gritty under the teeth; taste bitter, faintly astringent and aromatic; odour peculiar.

Composition.—The active purgative principle of rheum is probably identical with *cathartic acid*, the purgative constituent of senna. With this is combined *rheo-tannic* acid, possessing astringent properties. The yellow colouring matter is *chrysophanic acid* in small quantity; now made from araroba, and used for other purposes. (*See* page 231.) *Chrysophan*, $C_{16}H_{18}O_8$, is a yellow crystalline bitter glucoside. *Emodin*, *phæoretin*, and *oxalate of lime* (35 per cent.) are less important constituents.

Impurities.—English rhubarb, known by taste, odour, and excess of starch. Turmeric, reddened by boracic acid.

Dose.—As a stomachic, 1 to 5 gr.; as a purgative, 10 to 20 gr.

Preparations.

1. **Extractum Rhei.**—Spirituous. 100 in 39. *Dose*, 3 to 10 gr.
2. **Infusum Rhei.**—1 in 40. *Dose*, 1 to 2 fl.oz.
3. **Pilula Rhei Composita.**—Rhubarb, 3 oz.; Socotrine Aloes, 2¼ oz.; Myrrh, 1½ oz.; Hard Soap, 1½ oz.; Oil of Peppermint, 1½ fl.dr.; Treacle, 4 oz. *Dose*, 5 to 10 gr.
4. **Pulvis Rhei Compositus.**—"Gregory's Powder." Rhubarb, 2; Light Magnesia, 6; Ginger, 1. *Dose*, ½ to 1 dr.

5. Syrupus Rhei.—*Dose*, 1 to 4 fl.dr.
6. Tinctura Rhei.—1 in 10. *Dose*, as a stomachic, 1 to 2 fl.dr.; as a purgative, ½ to 1 fl.oz.
7. Vinum Rhei.—1 in 14. *Dose*, 1 to 2 fl.dr.

All preparations, excepting the Extract and Infusion, are compound.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

The action of rhubarb is confined to the alimentary canal. In small doses (1 to 5 gr.), the bitter principle and rheo-tannic acid are chiefly active, as **bitter stomachics and intestinal astringents.** In larger doses (up to 40 gr.) the cathartic acid exerts its influence before the rheo-tannic acid; **stimulates the intestinal movements and liver,** as in senna, with some griping; and causes **purgation,** producing in six to eight hours a liquid motion, of a yellow colour from the pigment of the rhubarb and excess of bile. The cathartic acid being expelled, the effect of the tannic acid becomes evident, and the bowels are confined.

Rhubarb is used in small doses as a bitter stomachic, intestinal astringent, and tonic, to correct atonic indigestion with diarrhœa, as in dyspeptic and rickety infants and children. Larger doses are given as a purgative, in the form of the Compound Powder, to sweep out the bowels and then set them at rest, in cases of summer diarrhœa and *diarrhœa ab ingestis* of children, combined sometimes with a mercurial. The Compound Pill is a familiar mild laxative for habitual use, suiting some persons, but demanding constant repetition in the majority. The cholagogue action of rhubarb adds to its value both in stomachic and purgative preparations. Its griping effect must be remembered, and the drug should never be given alone.

3. ACTION IN THE BLOOD, SPECIFIC, AND REMOTE LOCAL ACTION.

The chrysophan and chrysophanic acid, at least, are absorbed into the blood, pass through the tissues, and are thrown out in the secretions, which they stain yellow, including the urine.

MYRISTICACEÆ.

Myristica—Nutmeg.—The kernel of the seed of Myristica officinalis. Cultivated extensively in the Banda Islands of the Malayan Archipelago.

Bitter Stomachic.
Intestinal astringent.
Stimulant to liver
" . Intestinal movement
Purgative

Characters.—Oval or nearly round, about an inch in length, marked externally with reticulated furrows, internally greyish-red with dark-brownish veins. It has a strong peculiar odour, and a bitter aromatic taste.

Substance resembling Nutmeg: Areca, without odour.

Composition.—Nutmeg and mace contain about 30 per cent. of the officinal *concrete oil*, 4 to 9 per cent. of the officinal *volatile oil*, starch, etc. The *concrete* oil is a compound of (fluid) glycerides of oleic and butyric acids, and the solid glyceride of *myristic acid*, $C_{14}H_{28}O_2$, a little volatile oil, and resin. The *volatile* oil of nutmeg consists chiefly of a terpene, and an oxygenated oil, *myristicol*.

Preparations.

1. **Myristicæ Oleum Expressum.**—The concrete oil, obtained from nutmegs by expression and heat. Orange-coloured, with the odour of nutmeg.

From Myristicæ Oleum Expressum are prepared:

Emplastrum Calefaciens and Emplastrum Picis.

2. **Myristicæ Oleum.**—The volatile oil distilled in Britain from nutmegs. Colourless, fragrant. *Dose*, 2 to 6 min.

From Myristicæ Oleum is prepared:

Spiritus Myristicæ.—1 in 50. *Dose*, 30 to 60 min.

Nutmeg and the volatile oil are also contained in many preparations of more important drugs.

ACTION AND USES.

The solid oil has the **local stimulant** action of volatile oils, and is used as an inunction, or in plasters, to relieve the pain and swelling of chronic rheumatism, etc. The volatile oil resembles its many allies, and is chiefly used for culinary purposes.

LAURACEÆ.

Cinnamomi Cortex—Cinnamon Bark.—The inner bark of shoots from the truncated stocks of Cinnamomum zeylanicum. Imported from Ceylon, and distinguished in commerce as Ceylon Cinnamon.

Characters.—About one-fifth of a line thick, in closely-rolled quills, which are about four lines in diameter, containing several small quills within them, light yellowish-brown, with a fragrant odour and warm sweet aromatic taste: breaks with a splintery fracture.

Impurity : Cassia bark, rougher, thicker, less aromatic.

Composition.—Cinnamon bark contains the officinal *oil*, as well as *tannic acid*, *starch*, *sugar*, and *gum*. The oil is readily converted by exposure to air into cinnamic aldehyd, C_9H_8O, and cinnamic acid, $C_9H_8O_2$. See *Styrax*, page 334, and *Balsamum Peruvianum*, page 226.

Dose.—10 to 20 gr.

Preparations.

1. Aqua Cinnamomi.—1 in 8. *Dose*, 1 to 2 fl.oz.
2. Oleum Cinnamomi.—The oil distilled from cinnamon. Yellowish when recent, becoming red. *Dose*, 1 to 4 min.
3. Pulvis Cinnamomi Compositus.—Cinnamon, 1 ; Cardamoms, 1 ; Ginger, 1. *Dose*, 3 to 10 gr.
4. Tinctura Cinnamomi.—1 in 8. *Dose*, ½ to 2 fl.dr.

Cinnamon is also contained in a large number of preparations of other more important drugs, including the compound powders of Catechu, Chalk, and Kino.

ACTION AND USES.

Cinnamon, besides possessing the same action, and being used for the same purposes, as other **aromatic** substances (see *Caryophyllum*, page 242), has moderately **astringent** properties by virtue of its tannic acid. It is therefore the favourite flavouring and carminative agent in astringent powders, tinctures, etc. These are chiefly used in diarrhœa.

Camphora—Camphor.—A concrete volatile oil, obtained from the wood of Camphora officinarum. Imported in the crude state from China and Japan, and purified by sublimation in this country.

Characters and test.— White, translucent, tough, and crystalline ; has a powerful penetrating odour, and a pungent taste followed by a sensation of cold ; floats on water ; volatilises slowly at ordinary temperatures ; is slightly soluble in water, but readily soluble in rectified spirit and in ether, or when mixed with carbolic acid, chloral-hydrate, or thymol. It can be powdered by being rubbed with a few drops of spirit. Sublimes entirely when heated.

Composition.—Camphor is a solid volatile oil or stearoptene, with the composition $C_{10}H_{16}O$. Borneo Camphor or Baros Camphor, sometimes substituted for Japanese camphor, has the formula $C_{10}H_{18}O$, *i.e.* bears the same relation to Japanese camphor as alcohol to aldehyd.

Antiscorbutic
Nervous sedative.
Carminative
Anaphrodisiac.
Expectorant.
Refrigerant.

Impurities.—Borneo camphor, which sinks in water. Fixed salts, left on sublimation.

Dose.—1 to 10 gr.

Preparations.

1. **Aqua Camphoræ.**—About ½ gr. in 1 fl.oz. *Dose*, 1 to 2 fl.oz.
2. **Linimentum Camphoræ.**—1 to 4 of Olive Oil.
3. **Linimentum Camphoræ Compositum.**—1 in 9, with Strong Solution of Ammonia, Spirit, and Oil of Lavender.
4. **Spiritus Camphoræ.**—1 in 10. *Dose*, 10 to 30 min. (in milk or on sugar; an irritant preparation).
5. **Tinctura Camphoræ Composita.** — "Paregoric Elixir." Camphor, 30 gr.; Opium, 40 gr.; Benzoic Acid, 40 gr.; Oil of Anise, ½ dr.; Proof Spirit, 20 fl.oz. 1 fl.dr. contains ¼ gr. opium. (See *Opium*, p. 183.) *Dose*, 15 to 60 min.

Camphor is also contained in all except four liniments, and in two ointments.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally.—Camphor closely resembles other aromatic oils in its action, as described under *Terebinthinæ Oleum*, page 343. It is (1) weakly **antiseptic**; (2) **stimulating to the local circulation**; **and** (3) **sedative to the nerves, after preliminary stimulation.** The uses of camphor externally depend on these properties: the many liniments and ointments which contain it are intended to increase the nutrition of indurated or stiffened parts, to relieve pain, or to produce counter-irritation. The fluid compounds with carbolic acid, chloral, thymol, etc., are valuable anodynes.

Internally.—Camphor combined with carbolic acid forms an antiseptic and anæsthetic dressing for carious teeth. In the mouth it produces its peculiar taste, increase of the local circulation, salivation, and mucous flow. Reaching the stomach, it causes a sense of warmth; is a weak antiseptic; and again acts like turpentine. Briefly, it is a **carminative**, its purely local action stimulating digestion and relieving flatulence, and its reflex effects being visible in increased action of the heart, fulness and force of the pulse, and cerebro-spinal excitation. Its carminative properties, whilst generally applicable, are specially valuable in hysterical vomiting.

The intestinal effects of camphor are very similar, and it is therefore useful in some forms of diarrhœa, in the first stage of cholera, and in meteorism.

2. ACTION ON THE BLOOD.

Camphor enters the blood freely from the unbroken skin and mucous surfaces, and is found in it unchanged.

3. SPECIFIC ACTION AND USES.

In the organs and tissues a portion of the camphor administered is found unchanged; the rest appears to combine with glucose. The nervous system is chiefly affected by this drug, which in doses above those usually ordered may so act on the cerebrum as to produce a kind of **intoxication**, with confusion of mind, speech, gait, and gesture, and thereupon convulsions, probably originating in the medulla. Moderate doses are said to produce an aphrodisiac, followed by an anaphrodisiac, effect. Camphor has accordingly been used in nervous prostration, especially towards the end of acute specific fevers, such as typhoid; in poisoning by opium and other narcotics; in alcoholism, including delirium tremens; and in various nervous disorders, dependent probably on disturbance of the cerebral and spinal centres, such as insanity, hysteria, whooping cough, chordee or priapism, spermatorrhœa, etc. In large doses of particular preparations, and probably on certain subjects, instead of excitement camphor produces rapid depression, chiefly referable to the heart, namely, failure of the pulse, pallor, coldness and moistness of the surface, impaired local sensibility, and unconsciousness. The respiration is much disturbed after full doses, in association with convulsions and coma. Moderate doses, as we have seen, stimulate the heart reflexly from the stomach. The effect of camphor on metabolism is unknown; it lowers the body temperature both in health and in pyrexia, an action which may contribute to its value in fevers.

4. REMOTE LOCAL ACTION AND USES.

Camphor is excreted unchanged by the respiratory organs, on which it probably acts like turpentine, and is a common ingredient of **expectorant** mixtures, especially as the Compound Tincture. The skin also throws out camphor, which increases and gives its odour to the perspiration, the effect being **refrigerant**, and probably accounting for the use in common colds of the homœopathic solution, "spirit of camphor," which is a very powerful preparation, occasionally causing death. The kidneys do not excrete camphor as such, but as a complex product.

Sassafras Radix—SASSAFRAS ROOT.—The dried root of Sassafras officinale. From North America.

Characters.—In branched pieces, sometimes eight inches in diameter at the crown; bark externally greyish-brown, internally rusty-brown; of an agreeable odour, and a peculiar aromatic warm taste; wood light, porous, greyish-yellow, more feeble in odour and taste than the bark. Also in chips.

Composition.—Sassafras contains a *volatile oil*, consisting of a turpentine and a camphor; a resin; and a neutral crystalline body, *sassafrin*.

Sassafras is contained in Decoctum Sarsæ Compositum.

ACTION AND USES.

The physiological action of sassafras is unknown. The drug is rarely used alone, but in the Compound Decoction of Sarsaparilla. It is supposed to increase the action of the skin and kidneys in syphilis, rheumatism, etc., and thus to be an **alterative**. See *Sarsæ Radix*, page 354.

Nectandræ Cortex—BEBEERU BARK.—The bark of Nectandra Rodiæi, the Greenheart Tree. Imported from British Guiana.

Characters.—In large flat heavy pieces, from one to two feet long, from two to six inches broad, and about a quarter of an inch thick. External colour greyish-brown; internal colour dark cinnamon-brown. Taste strongly and persistently bitter, with considerable astringency.

Composition.—The active principle of bebeeru bark is *beberia* or *biberin*, $C_{36}H_{40}N_2O_6$, a bitter alkaloid, the sulphate of which is officinal. It also contains tannin.

From Nectandræ Cortex is made:

Beberiæ Sulphas ($C_{36}H_{40}N_2O_6.H_2SO_4$).—The sulphate of an alkaloid prepared from Bebeeru Bark.

Source.—Made by (1) exhausting the powdered Bark with Water and Sulphuric Acid; (2) precipitating the colouring matter with Lime; (3) filtering and precipitating impure Beberia by Ammonia; (4) making a tincture, and therefrom a solution in Diluted Sulphuric Acid; (5) purifying and evaporating to dryness.

Characters.—Dark-brown thin translucent scales; yellow when in powder; with a strong bitter taste. Solubility, 1 in 80 of water; sparingly in spirit.

Incompatibles.—Alkalies and their carbonates, bromide and iodide of potassium, lime-water, tartaric acid and tartrates astringent infusions and tinctures.

Dose.—1 to 10 gr.

ACTION AND USES.

Bebeeru bark is an **aromatic bitter, stomachic and tonic** in its effects, like orange and cascarilla; the alkaloid possesses the properties of a pure bitter.

Like all other substances of this class, beberia is antiseptic, and to a small extent **antipyretic and antiperiodic**; but these effects being comparatively insignificant, its use in fever and ague has now been abandoned.

ARISTOLOCHIÆ.

Serpentariæ Radix—SERPENTARY ROOT.—The dried rhizome of Aristolochia Serpentaria. From the southern parts of North America.

Characters.—A small roundish rhizome, with a tuft of numerous slender rootlets, about three inches long, yellowish; of an agreeable camphoraceous odour, and a warm bitter camphoraceous taste.

Composition.—Serpentary contains chiefly a *volatile oil* and *resin*, with some *bitter* principle.

Preparations.

1. **Infusum Serpentariæ.**—1 in 40. *Dose*, 1 to 2 fl.oz.
2. **Tinctura Serpentariæ.**—1 in 8. *Dose*, ½ to 2 fl.dr.

ACTION AND USES.

Serpentary possesses **local and general stimulant and tonic** properties, closely resembling those of valerian and cascarilla. It is occasionally used in low, nervous, despondent, and excitable conditions, as well as in low fevers and febrile states.

THYMELACEÆ.

Mezerei Cortex—MEZEREON BARK.—The dried bark of Daphne Mezereum, Mezereon; or of Daphne Laureola, Spurge Laurel. British; the latter cultivated.

Characters.—In strips or quilled pieces of various lengths, tough and pliable, olive-brown on the surface, white within, fibrous, odour faintly nauseous, taste hot and acrid.

Composition.—Mezereon contains an acrid *resin*, which is the anhydrid of a resinous acid *mezereinic acid;* an inert *fixed oil;* and a glucoside *daphnin*, also probably inactive.

Bitter
Stomachic
Antidyspeptic
Antiperiodic

Irritant
Vesicant.
Alterative.

Preparations.

Extractum Mezerei Æthereum.—8 gr. to 1 fl.oz.

From Extractum Mezerei Æthereum is prepared:

Linimentum Sinapis Compositum.

Mezereum is also an ingredient of Decoctum Sarsæ Compositum. 60 gr. in 1 pint.

ACTION AND USES.

Mezereon is a powerful **local irritant**, like cantharis or mustard, **causing vesication.** Internally it is a stimulant and diaphoretic; it is in large doses an irritant poison. It is not employed alone, the ethereal extract being an ingredient of Linimentum Sinapis Compositum, and the internal use of the drug confined to Decoctum Sarsæ Compositum as an **alterative**, in syphilis, chronic rheumatism, and skin diseases.

EUPHORBIACEÆ.

Cascarillæ Cortex—CASCARILLA BARK.—The bark of Croton Eluteria. From the Bahama Islands.

Characters.—In quills, two or three inches in length, and from two to five lines in diameter, dull brown, but more or less coated with white crustaceous lichens; breaks with a short resinous fracture; is warm and bitter to the taste; and emits a fragrant odour when burned.

Substance resembling Cascarilla: Pale Cinchona Bark, which is less white, smooth, and small.

Composition.—Cascarilla contains a complex mixture of *aromatic oils and resin*, a crystalline bitter principle, *cascarillin*, and some tannin, etc.

Incompatibles.—Lime-water, metallic salts, mineral acids.

Preparations.

1. Infusum Cascarillæ.—1 in 10. *Dose*, 1 to 2 fl.oz.
2. Tinctura Cascarillæ.—1 in 8. *Dose*, ½ to 2 fl.dr.

ACTION AND USES.

Cascarilla acts in virtue of the aromatic oils and the bitter principle which it contains. It is a pleasant and useful **aromatic bitter stomachic**, but is somewhat difficult to dispense, as the infusion readily decomposes, and the resin separates from the tincture when prescribed with acids.

Oleum Crotonis—Croton Oil.—The oil expressed from the seeds of Croton Tiglium.

Characters of the seeds.—About the size of a grain of coffee, oval or oval oblong, dull brownish-grey, without odour.

Substance resembling Croton Oil Seed: Castor Oil Seed, which is larger, bright, polished, and marbled.

Characters of the oil.—Slightly viscid; colour brownish-yellow; taste acrid; odour faintly nauseous.

Composition.—The active principle of croton oil is *crotonic acid*, $C_9H_{11}O_2$, a fatty acid, partly free, partly combined with glycerine. With this there are present many *fixed oils* (oleic, palmitic, stearic, myristic and lauric) as well as their free acids; and several *volatile acids* (1 per cent. in all), which give its odour to croton oil, viz. acetic, butyric, baldriac and tiglic acids, and are derived from the fixed oils after extraction only.

Impurities.—Other fixed oils.

Dose.—$\frac{1}{2}$ to 1 min. placed on the tongue or in crumb of bread.

Preparation.

Linimentum Crotonis.—1 in 8, with Oil of Cajuput.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally.—Croton oil is a **powerful irritant** to the skin, causing a burning sensation and redness, followed by a crop of papules, and finally severe pustules, which last for days, heal by scabbing, and may leave unsightly cicatrices. Croton oil liniment is much less used than formerly as a counter-irritant in affections of internal parts, especially the lungs and joints.

Internally, also, croton oil is a powerful irritant, causing burning in the throat, heat in the epigastrium, possibly nausea, and purgation. It acts as a very rapid **drastic cathartic**, with some pain, producing a motion within 1 to 2 hours, which is partly solid, the effect being repeated several times during the next twelve hours in a more liquid form. The irritant effect consists chiefly in direct inflammation of the mucous membrane, with increased watery transudation, heightened peristaltic action, probably glandular (not biliary) hypersecretion. The muscular excitement, and consequent griping which it produces, commence before the oil has reached the duodenum, to be acted on by the pancreatic juice and bile, and are, therefore, partly reflex acts, originating in irritation of the gastric nerves by the free portion of the crotonic acid, section of the vagi postponing its purgative action. This accounts for the rapid action of the drug.

Irritant
Drastic purgative

Purgative followed by sedative effect

Croton oil is used when a speedy and complete evacuation of the bowels, and diminution of the arterial pressure, are demanded. It is a proper purgative in some cases of apoplexy; in intestinal obstruction from impacted fæces; or where other purgatives have failed in constipation, and an organic obstacle does not exist. The smallness of the dose, which can be put in food, renders it a convenient purgative for insane and unconscious patients. Croton oil must always be given with great care; and is inadmissible in feeble subjects, in organic obstruction, and in inflammatory states of the stomach and intestines.

2. ACTION IN THE BLOOD; SPECIFIC, AND REMOTE LOCAL ACTION.

Crotonic acid, or its products, are occasionally absorbed, and cause disturbance of the heart and nervous centres.

Oleum Ricini—CASTOR OIL.—The oil expressed from the seeds of Ricinus communis. Imported chiefly from Calcutta.

Characters of the seeds.—Oval, somewhat compressed, smooth and shining, grey, marbled with reddish-brown or blackish-brown spots and stripes.

Substance resembling Castor Oil Seed: Croton Oil Seed (q.v.).

Characters of the oil.—Viscid, colourless, or pale straw yellow, having a slightly nauseous odour and a somewhat acrid taste. Entirely soluble in one volume of alcohol and in two volumes of rectified spirit.

Composition.—The bulk of castor oil consists of *ricinoleic acid*, $C_{18}H_{34}O_3$, combined with glycerine. Palmitin, stearin, cholesterin, and possibly a resin and an alkaloid also occur in small quantities.

Dose.—1 to 8 fl.dr.

Preparations.

Oleum Ricini is contained in: Collodium Flexile (1 in 49), Linimentum Sinapis Compositum (1 in 9), and Pilula Hydrargyri Subchloridi Composita (1 in 5).

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally, pure castor oil is bland, like almond oil; and is applied as a local sedative and protective, for instance, in injury of the conjunctiva by quicklime.

Internally.—Castor oil is perfectly non-irritant if pure, until it reaches the duodenum, where it is decomposed by the pancreatic juice, and the ricinoleic acid at once comes into action. If the oil be rancid, irritation of the stomach will cause nausea and vomiting.

Castor oil is a **simple purgative**, at once rapid and certain, mild and painless, producing one or more liquid but not watery stools in four to six hours, **followed by a sedative effect.** It is believed to stimulate the muscular coat and intestinal glands, but not the liver. It also purges when given as enema.

Castor oil is used as the best of all simple purgatives when a free evacuation of the bowels only is desired. It can be given in all conditions where a laxative is permissible, and is therefore specially employed in the treatment of diarrhœa due to the presence of indigestible or undigested food in the bowels, in the constipation of typhoid fever, after abdominal operations, in pregnancy, and *post-partum.* It is a valuable purgative for children and for the old and infirm. In some forms of indigestion in infants, and of chronic obstruction of the bowels, small doses (5 min. for an infant), may be given three or four times a day for days or even weeks, as an emulsion, with the best result. Small doses of tincture of opium are sometimes combined with castor oil.

2. ACTION ON THE BLOOD; SPECIFIC, AND REMOTE LOCAL ACTION.

Ricinoleic acid enters the blood and tissues, and leaves the body in the excretions, including the milk, which purges the infant at the breast.

The *Leaves* of the Castor Oil Tree, applied locally to the mamma as a poultice, are said to be galactagogue.

Kamala—KAMALA.—A powder which consists of the minute glands that cover the capsules of Rottlera tinctoria. Imported from India.

Characters.—A fine granular mobile brick-red powder, with little odour or taste; difficult to mix with water; mainly soluble in alcohol and ether, the residue consisting principally of tufted hairs.

Impurities.—Sand or earth. *Resembles* Oxide and Iodide of Mercury, but is not heavy.

Composition.—Kamala contains an active resin, *rottlerin,* allied to coussin (see *Cusso*), *tannin,* red colouring matter, etc.

Dose.—30 gr. to ½ oz., as an electuary with tamarinds.

ACTION AND USES.

Kamala is an **anthelmintic** and slight gastro-intestinal irritant, sometimes causing nausea, vomiting, colic, and diarrhœa. It is used to expel the tape-worm, lumbricoid, and oxyuris.

PIPERACEÆ.

Piper Nigrum—BLACK PEPPER.—The dried unripe berries of Piper nigrum. Imported from the East Indies.

Characters.—Small, roundish, wrinkled; tegument brownish-black, containing a greyish-yellow globular seed. Odour aromatic. Taste pungent, and bitterish.

Substances resembling Black Pepper: Pimento, which has calyx; Cubebs, which has stalk.

Composition.—Pepper contains a *volatile oil*, isomeric with turpentine, with the odour of pepper; a complex *resin;* a tasteless crystalline alkaloid, *piperin*, $C_{17}H_{19}NO_3$, that is, isomeric with morphia; and *chavicin.*

Dose.—5 to 20 gr.

Preparation.

Confectio Piperis.—1 in 10. *Dose*, 1 to 2 dr.

Pepper is also contained in Confectio Opii (1 in 31), and Pulvis Opii Compositus (1 in 7½).

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally, pepper is a domestic rubefacient, anodyne, and counter-irritant, like mustard.

Internally, it acts as a local **stimulant aromatic** in the mouth, stomach, and intestine. As a familiar condiment, it assists gastric digestion like other substances of the same class.

2. ACTION IN THE BLOOD, AND SPECIFIC ACTION AND USES.

The volatile oil of pepper acts on the blood and tissues like its allies. Piperin is believed to possess the antiperiodic and antipyretic action of other alkaloids such as quinia; and pepper was once a domestic remedy for ague, which may still be used when the appetite fails.

3. REMOTE LOCAL ACTION AND USES.

Some of the constituents of pepper are excreted by the kidney, and probably by the intestinal mucous membranes, and

act as **remote local stimulants of the** circulation and nutrition in the **urethra and rectum.** Pepper is occasionally used in gleet; but much more extensively for hæmorrhoids and other diseases of the rectum.

Cubeba—Cubebs.—The dried unripe fruit of Cubeba officinalis. Cultivated in Java.

Characters.—The size of black pepper, globular, wrinkled, blackish, supported on a stalk of rather more than its own length; has a warm camphoraceous taste and characteristic odour.

Substances resembling Cubebs: Pimento and Black Pepper, which have no stalk.

Composition.—Cubebs consists of 6 to 15 per cent. of the officinal *volatile oil;* 2 per cent. of a neutral, odourless, and tasteless body, insoluble in water, *cubebin*, $C_{10}H_{10}O_3$; 6 per cent. of a *resin* containing *cubebic acid;* a fatty oil; and gum. Volatile oil of cubebs, $C_{15}H_{24}$, is colourless or pale greenish-yellow, smelling of cubebs.

Dose.—30 to 120 gr.

Preparations.

1. **Oleum Cubebæ.**—The oil distilled in Britain from Cubebs. *Dose*, 5 to 20 min., with mucilage and syrup.
2. **Tinctura Cubebæ.**—1 in 8. *Dose*, ½ to 2 fl.dr.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

The action of cubeb pepper closely resembles that of common pepper, but different parts of the body are affected in different degrees.

Cubebs is an aromatic stomachic, in small doses; in large doses it is apt to derange the digestion; and in very large doses it is a gastro-intestinal irritant. It is sometimes applied to the pharynx in chronic inflammation, and very rarely it is given in chronic dyspepsia.

2. ACTION ON THE BLOOD, AND SPECIFIC ACTION.

The active principles of cubebs enter the *blood*, and thence the *tissues*. Large doses probably have an action similar to turpentine, but no use is made of it on this account.

3. REMOTE LOCAL ACTION.

The principal effects of cubeb pepper are produced when it is leaving the body by the kidneys and urinary passages,

Diuretic.
Stimulant to Genito-urinary
tract. - Gonorrhea.
Anthelmintic

the skin, and the respiratory organs. In this respect it closely resembles copaiba, and is used in the same class of cases with it. Thus, it is a **diuretic**, acting directly on the renal cells. The cubebic acid is excreted in the urine as a salt, from which it may be precipitated by nitric acid; and **stimulates and disinfects the genito-urinary passages** with which it **comes in contact**. The sweat and the bronchial mucus are both increased, and sometimes an eruption appears on the skin.

Cubebs is rarely used except in gonorrhœa and vesical affections. It is decidedly less unpleasant than copaiba, and much less liable to disturb digestion. It is sometimes prescribed for chronic bronchitis.

Maticæ Folia—Matico Leaves.—The dried leaves of Artanthe elongata. Imported from Peru.

Characters.—From two to eight inches long, veined and tesselated on the upper surface, downy beneath; with an aromatic, slightly astringent, warm taste, and an agreeable aromatic odour.

Substance resembling Matico: Digitalis. (*See* page 309.)

Composition.—Matico contains a quantity of *volatile oil*, *artanthic acid* (crystalline), *resin*, and *tannic acid*.

Preparation.

Infusum Maticæ.—1 in 20. *Dose*, 1 to 4 fl.oz.

ACTION AND USES.

Matico is said to **resemble pepper and cubebs** very closely in its action, and has been given in the same class of cases, but is not in general use. The physical character of the under surface of the leaf renders it a **local hæmostatic** when applied to incised wounds, as it facilitates coagulation.

SALICACEÆ.

Salicis Cortex—Willow Bark. (*Not Officinal.*)—The bark of Salix caprea, and other species.

Characters.—Quilled pieces, the epidermis dark, the structure fibrous and tough; odour slightly aromatic; taste bitter and astringent.

Composition.—Willow bark contains *salicin*, *tannic acid*, and the ordinary constituents of barks.

Non-officinal Preparations.

1. **Salicinum.**—Salicin, $C_{13}H_{18}O_7$. A neutral principle in silky acicular crystals, or white tables; odourless, bitter. Solubility, 1 in 20 of water. *Dose,* 5 to 30 gr.

2. **Acidum Salicylicum,** $C_7H_6O_3$, or $H_2.C_7H_4O_3$. *Source.*—Prepared from the oil of Gaultheria procumbens (Winter Green), or commercially by passing a stream of Carbonic Acid over a heated mixture of Carbolic Acid and Caustic Soda, decomposing by Hydrochloric Acid, and purifying.

Characters.—Light acicular crystals; odourless, but irritant to the nostrils; with a sweetish taste. Solubility, 1 in 760 water; 1 in 4 of spirit.

Dose.—5 to 30 gr. or more.

From Acidum Salicylicum is prepared:

Sodæ Salicylas, $Na_2.C_7H_4O_3$. *Source.*—Made by neutralising the Acid by Bicarbonate of Soda in water; or as the acid without the final decomposition.

Characters.—Shining silky tabular crystals, or a white crystalline powder, odourless, with a sweetish unpleasant taste. Solubility, 1 in 1 of water.

Dose.—10 to 30 gr.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally.—Salicylic acid acts as an **antiseptic and disinfectant,** not inferior to carbolic acid. At the same time it stimulates the local circulation. It is extensively used as a surgical dressing in the form of cotton wool impregnated with the acid by the aid of glycerine. On the contrary, salicylate of soda has no antiseptic or disinfectant power, unless combined with a mineral acid to liberate the salicylic acid. Salicylic acid in powder, diluted with talc, is a **anhidrotic,** checking local perspirations of the feet, or the general perspirations of phthisis. Neither substance is absorbed by the unbroken skin.

Internally.—Salicylic acid causes sneezing and cough when applied to the nose, or inhaled, like benzoic acid; and when admitted to the stomach, it is also a local irritant, causing heat, pain, nausea, and vomiting, unless in moderate and well-diluted doses. The soda salicylate is very much less irritant, and may be freely administered if pure. The latter drug is used for sarcinous vomiting, and in some cases of chronic dyspepsia with decomposition. Salicin is easily borne by the stomach. In the bowel it is converted into saligenin ($C_7H_8O_2$) and glucose;

Antiseptic & disinfectant
Antiscabagogue
Antihydrotic
Reduces temperature
Therapic in Malaria.

and the former is in turn broken up into salicyluric ($HC_9H_8NO_4$), salicylic, and salicylous acids ($C_7H_6O_2$). Salicylous acid is a local irritant.

2. ACTION ON THE BLOOD AND ITS USES.

Salicylic acid necessarily exists in the blood as the salicylate of soda, being taken up with considerable rapidity. The acid is possibly again liberated in part by the free carbonic acid of the plasma in inflamed parts of the body, and thus exerts its antiseptic action within the body; but this is doubtful. Either in the blood, or in some of the tissues, a portion unites with glycocoll (just like benzoic acid), and forms salicyluric acid (comparably with hippuric acid), thus: $C_7H_6O_3 + C_2H_5NO_2$ (glycocoll) $= H.C_9H_8NO_4$ (salicyluric acid) $+ H_2O$.

As regards salicin, the decomposition begun in the bowel is continued in the blood.

3. SPECIFIC ACTION AND USES.

The action of salicylic acid and its sodium salt is identical in the tissues, since the former is converted into the latter. A moderate dose causes increased cardiac action, flushing and warmth of the surface, perspiration, a full feeling in the head, tinnitus, deafness, impairment of vision, and possibly a **slight fall of temperature**, although the nitrogenous waste is said to be increased. Larger doses may cause delirium. Respiration is temporarily disturbed; the heart is depressed after the primary excitation; the vessels are relaxed, and the blood pressure falls; perspiration is increased; the peripheral nerves, both sensory and motor, are unaffected.

All these phenomena in the healthy subject, taken together, do not account for the remarkable effect of salicylates upon the body temperature in pyrexia or fever. Of all antipyretics these appear to be the most powerful, two or more moderate doses (15 to 20 gr.) within one or two hours **reducing pyrexial temperatures several degrees**, according to the disease and the subject. It is therefore probable that the salicylates act upon some *pathological* cause of pyrexia, possibly the organisms of the specific fevers.

Salicylate of soda is employed in two allied but distinct classes of cases: 1. In pyrexia from any cause, such as typhoid fever, pneumonia, pyæmia, etc., it is a simple and powerful **antipyretic**. In this respect it is comparable with quinia; only more rapid in its action, less lasting in its effects, and more depressant to the circulation. It may be given in these diseases in single full doses when the temperature exceeds a certain height, say 104° Fahr. 2. In acute rheumatism, salicylate

of soda is distinctly a specific (much as quinia is a specific against malaria), reducing the temperature, relieving the pain, removing the swelling and other local symptoms, and shortening the duration of the disease. By thus curtailing the course of rheumatism, this drug may indirectly reduce the liability to cardiac and other complications; but it is of no great service directly in this respect. It is of no use in chronic rheumatism or in gout; of doubtful value in rheumatic sciatica. It may be given either in wafers or in solution; and in this country it is now often combined with bicarbonate of potash in free doses (20 gr.). When the pyrexia declines, the dose of the salicylate must be most gradually reduced, as relapses are extremely common after it has been discontinued.

Diphtheria and diabetes have sometimes been successfully treated with salicylates.

Salicin may be used for the same purposes as the salicylates; its action, if less powerful, being better sustained, and the cardiac and vascular depression less marked.

4. Remote Local Action and Uses.

Salicylic acid is slowly excreted in the urine, sweat, saliva, bile, and mucous secretions generally, mostly as the salicylate or the free acid, partly as salicyluric acid.

Its most important action remotely is on the kidneys and urinary passages, where it is a stimulant and disinfectant, at the same time increasing the acidity. It is thus adapted for the treatment of chronic inflammatory affections of the bladder, with foul alkaline urine and phosphatic deposits. Sometimes, however, it so irritates the kidney as to cause albuminuria and even hæmaturia; and it must be used with great caution, for these or other purposes, if renal disease be present.

LIQUIDAMBARACEÆ.

Styrax Præparatus—Prepared Storax.—A balsam obtained from the bark of Liquidambar orientale. Purified by means of rectified spirit and straining.

Characters.—A semi-transparent brownish-yellow semi-fluid resin, of the consistence of thick honey, with a strong agreeable fragrance and aromatic bland taste. Heated in a test tube on the vapour bath, it becomes more liquid but gives off no moisture; boiled with solution of bichromate of potash and sulphuric acid it evolves the odour of hydride of benzoyl.

Composition.—Storax consists of a volatile oil, *styrol*, C_8H_8,

cinnamic acid, cinnamate of cinnamic-æther (styracin), and various resins. Cinnamic acid, $C_9H_8O_2$, which occurs also in the balsams of Peru and Tolu, is a colourless, odourless, crystalline body, closely allied to benzoic acid, being excreted in the urine partly as hippuric acid.

Dose.—5 to 20 gr.

Storax is contained in :

Tinctura Benzoini Composita.—33 gr. in 1 fl.oz.

ACTION AND USES.

Storax is a **local and remote stimulant, antiseptic, and disinfectant,** like benzoin and the balsams of Peru and Tolu. It is used for scabies and phthiriasis.

ULMACEÆ.

Ulmi Cortex—Elm Bark.—The dried inner bark of Ulmus campestris, Broad-leaved Elm. From trees indigenous to and cultivated in Great Britain.

Characters.—A tough brownish-yellow bark, about half a line thick, without smell; taste mucilaginous, slightly bitter and astringent.

Composition.—Elm bark contains about 3 per cent. of *tannic acid*, 20 per cent. of *mucilage*, and a peculiar brown body, *ulmin*, insoluble in water.

Incompatibles.—Persalts of iron, salts of lead and silver, and gelatine.

Preparation.

Decoctum Ulmi.—1 in 8. *Dose*, 2 to 4 fl.oz.

ACTION AND USES.

Elm bark has a similar action to oak bark and tannic acid, but is **demulcent as well as astringent.**

CUPULIFERÆ.

Quercus Cortex—Oak Bark.—The dried bark of the small branches and young stems of Quercus pedunculata. Collected in spring, from trees growing in Great Britain.

Characters.—Covered with a greyish shining epidermis, cinnamon-coloured on the inner surface, fibrous, brittle, and strongly astringent.

Substance resembling Oak Bark: Pale Cinchona Bark, which is bitter.

Composition.—Oak bark contains 4 to 20 per cent of *tannic* and *gallic acids*, *pectin*, and other constituents of plants.

Incompatibles.—Those of tannic and gallic acids.

Preparation.

Decoctum Quercûs.—1 in 16. *Dose*, 1 in 2 fl.oz. Seldom given internally.

Galla—Galls.—Excrescences on Quercus infectoria, caused by the punctures and deposited ova of Diplolepis Gallæ tinctoriæ.

Characters.—Hard heavy globular bodies, varying in size from half an inch to three-fourths of an inch in diameter, tuberculated on the surface, the tubercles and intervening spaces smooth; of a bluish-green colour on the surface, yellowish-white within, with a small central cavity; intensely astringent.

Composition.—Galls contain from 15 to 65 per cent. of *tannic acid*, about 5 per cent. of *gallic acid*, and other less important constituents.

Preparations.

1. **Tinctura Gallæ.**—1 in 8. *Dose*, ½ to 2 fl.dr. Seldom used except as a test.
2. **Unguentum Gallæ.**—1 in 6½.

From Unguentum Gallæ is prepared:

Unguentum Gallæ cum Opio.—1 of Opium to 14⅔ of Ointment of Galls.

From Galla are also made:

1. Acidum Tannicum.—Tannic Acid. Tannin. $C_{27}H_{22}O_{17}$. An acid extracted from galls.

Source.—Made by exposing powdered galls to a damp atmosphere; macerating with ether; pressing; and partially evaporating and drying the liquid portion.

Characters.—Pale yellow vesicular masses, or thin glistening scales, with a strong astringent taste, and acid reaction. Solubility: 10 in 8 of water or spirit; sparingly in ether; 1 in 3 of glycerine.

Incompatibles.—Gelatine (which it precipitates, distinguishing it from gallic acid), mineral acids, alkalies;

Diphtheria + Astringent.

salts of antimony, lead, silver; persalts of iron, alkaloids, vegetable emulsions.

Dose.—2 to 10 gr.

Preparations.

a. Glycerinum Acidi Tannici.—1 to 4. *Dose*, 10 to 40 min.

b. Suppositoria Acidi Tannici.—3 gr. in each.

c. Suppositoria Acidi Tannici cum Sapone.—3 gr. in each.

d. Trochisci Acidi Tannici.—½ gr. in each. *Dose*, 1 to 6.

2. Acidum Gallicum.—Gallic Acid. $H_3C_7H_3O_5.H_2O$. A crystalline acid prepared from galls.

Source.—Made by fermenting a paste of powdered galls and water, boiling with water, straining, and purifying the crystalline product.

Characters.—White or pale fawn silky needles, with an acid taste. Solubility: 1 in 100 of cold water, 1 in 3 of boiling water, 1 in 8 of spirit, 1 in 20 of glycerine. It may be combined with the *proto*-salts of iron. *Resembles* Tannic Acid, but has no astringent taste, and does not precipitate solutions of gelatine.

Incompatibles.—Spiritus Ætheris Nitrosi; metallic salts, including *per*-salts of iron.

Dose.—3 to 10 gr.

Preparation.

Glycerinum Acidi Gallici.—1 to 4. *Dose*, 10 to 60 min.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally.—The action of tannic acid, and of the many officinal substances which contain it, including oak-bark and galls, depends upon its property of **precipitating albumen and gelatine.** When applied to the skin or exposed mucous surfaces, it condenses or constringes the albuminous and connective tissues, and coagulates the fluids pervading the solid elements (an action which in the dead skin converts the whole into leather). At the same time the sensibility of the nerves is reduced. The vessels are compressed by the constringed tissues to such a degree that their size is indirectly reduced, the circulation through them diminished, and hæmorrhage from them arrested by pressure and by coagulation of the blood by the acid. If a

"passive" discharge of plasma and leucocytes is escaping from their walls, as in chronic inflammation, the exudation is stopped. Thus tannic acid is a powerful indirect **styptic and astringent.** Broken surfaces, such as ulcers, have their superficial layers of cells condensed, and the discharge disinfected and coagulated, thus promoting healing. It is a remarkable fact that tannic acid does not actively contract blood-vessels, like lead and silver; on the contrary, it dilates them; but the indirect or constringent influence more than neutralises this.

There is hardly a limit to the application of tannic acid, and preparations containing it, as astringents and styptics. Superficial hæmorrhage from small wounds, the nose, gums, throat, etc., and chronic or subacute inflammatory discharges from the skin, eyes, nose, urethra, vagina, womb, or rectum, may all be treated with it. The acid may be used solid, being dusted or insufflated on the part; in solution as injection, lotion, etc.; or inserted into canals or cavities as bougies or suppositories. The two ointments of galls are favourite applications to hæmorrhoids.

Internally.—In the mouth, tannic acid produces its peculiar "taste," with a sensation of astringency, dryness, roughness, stiffness of the tongue and throat, and thirst; the parts being constringed and partially anæsthetised, and the other effects produced, as described, externally. Preparations containing this drug are in much request in chronic sore throat with a relaxed condition of the uvula, pharynx, and larynx, slight catarrh, cough, and occasional slight bleeding. The trochisci, gargles, sprays, or the glycerine applied with a brush, may be used in different cases.

In the stomach, tannin precipitates the pepsin with the albumens of the gastric juice; and if in quantity, will interfere with digestion by this means, as well as by constringing the mucosa, reducing the circulation, and diminishing the secretion. On the contrary, if a chronic gastric catarrh be present, causing dyspepsia, tannin will give relief by arresting the morbid process, on the principles already discussed. Hæmorrhage from ulcer of the stomach is often successfully treated by free (1 dr.) doses of the acid, which acts as a direct styptic. In the stomach another highly important use is made of the drug, viz. as an antidote to antimony, and such alkaloids as morphia, nicotin, strychnia, etc.; a strong infusion of tea being given if no other tannate is at hand. An emetic or purgative should be afterwards given in alkaloidal poisoning, as the compounds with tannic acid are not perfectly insoluble.

The astringent effect of tannin is continued in the in-

testines, where it and its compounds are the most popular remedies for diarrhœa, whether alone or combined with other astringents, antacids such as chalk, or anodynes such as opium. Intestinal hæmorrhage may sometimes be arrested by the same means. During its passage along the alimentary canal, part of the tannin is converted into gallic acid, which enters the blood; the rest is excreted in the fæces.

Tannic acid + water = gallic acid + glucose.

$$C_{27}H_{22}O_{17} + 4H_2O = 3H_3C_7H_3O_5 + C_6H_{12}O_6.$$

Gallic acid possesses no local astringent or antiseptic properties, and is therefore seldom if ever given for immediate local purposes.

2. ACTION ON THE BLOOD, AND ITS USES.

Entering the circulation as gallic acid, the preparations of tannin are not certainly known to have any further astringent effect on the vessels, any antiseptic action, or coagulating influence on the blood. If injected directly into the veins, tannic acid would prove rapidly fatal by clotting and embolism.

3. SPECIFIC ACTION AND USES.

The action of these substances on the tissues must depend entirely on the gallic acid. In full doses gallic acid causes circulatory depression, by weakening the heart and dilating the vessels; and it also causes dyspnœa. But besides these effects determined by experiment, it is almost universally regarded to be a specific astringent and **hæmostatic**, and thus to arrest chronic discharges from internal and distant parts, such as the uterus and rectum, and to check bleeding, especially hæmoptysis. Gallic acid is much used for these purposes, and should be given in full doses—even up to one drachm at a time if hæmorrhage be urgent. It must be confessed that some authorities do not believe in this action or use of the drug.

4. REMOTE LOCAL ACTION AND USES.

Tannic and gallic acids are rapidly excreted, chiefly as gallic acid, partly also as pyrogallic acid, in the urine, which is darkened in tint. No remote disinfectant effect is to be obtained in the kidneys or bladder; nor is gallic acid now believed to diminish the albuminuria of Bright's disease. Some hold that it arrests renal hæmorrhage; but in this, and in all kinds of hæmorrhage, there is a constant possible source of error, from the fact that the spontaneous arrest of bleeding is extremely common.

Gallic acid has also been used in night-sweats, with doubtful success.

Acidum Pyrogallicum — Pyrogallic Acid. Pyrogallol. $C_6H_3(OH)_3$. (*Not Officinal.*)—A body obtained from gallic or tannic acid by carefully heating.

Characters.—Very small shining colourless crystals, becoming black on exposure; odourless, insipid; not acid to test-paper; readily soluble in water.

Dose.—½ to 1½ gr.

ACTION AND USES.

Pyrogallic acid has a powerful affinity for oxygen, and is thus **antiseptic and disinfectant** (in 1 to 2½ per cent. solutions). It stains the skin and hair dark without injuring their structure. It also acts as a powerful but somewhat painful local stimulant, which will destroy excessive cutaneous growths, and may be used (60 gr. to one ounce of lard) in psoriasis, but only when the patches of disease are small, in lupus, and in epithelial cancer.

Whether applied freely to the skin, or given internally in large doses, pyrogallic acid has a destructive influence on the blood, which assumes a brown "fluid" appearance and readily coagulates, the corpuscles being the elements affected. Vomiting, purging, bloody urine, great nervous and general depression, are the results of this blood change, which may prove fatal; hence the caution given in the last paragraph. The drug has been used in hæmoptysis.

MORACEÆ.

Ficus—Fig.—The dried fruit of Ficus Carica. Imported from Smyrna.

Composition.—Figs contain chiefly *sugar* and *mucilaginous* substances.

Figs are contained in Confectio Sennæ.

ACTION AND USES.

The dried fig is a very pleasant **demulcent and nutritive** substance with **laxative** properties, and may be ordered as an article of diet in habitual constipation. It is sometimes used locally as a poultice to gum-boils.

antiseptic + disinfectant.
Destroys blood Corpuscles,
giving blood a brown colo

Mori Succus—Mulberry Juice.—The Juice of the ripe fruit of Morus nigra.

Characters.—Of a dark violet colour, with a faint odour, and an acidulous sweet taste.

Preparation.

Syrupus Mori.—*Dose*, 1 to 2 fl.dr.

ACTION AND USE.

Mulberry juice is a pleasant flavouring and colouring agent.

CANNABINACEÆ.

Cannabis Indica—Indian Hemp.—The dried flowering tops of the female plants of Cannabis sativa. For medicinal use that which is grown in India, and from which the resin has not been removed, is alone to be employed.

Characters.—Tops consisting of one or more alternate branches, bearing the remains of the flowers and smaller leaves and a few ripe fruits, pressed together in masses which are about two inches long, harsh, of a dusky-green colour and a characteristic odour. Various preparations are known in different parts of the East, as Bang, Hashish, Churrus, and Gunjah.

Composition.—Cannabis indica contains a brown amorphous resin, *cannabin*, and a volatile oil, *cannaben*, either or both of which may be the active principle.

Preparations.

1. Extractum Cannabis Indicæ.—Alcoholic. 6 in 1. *Dose*, ¼ to 1 gr.
2. Tinctura Cannabis Indicæ.—1 in 20. *Incompatibles*, water and watery infusions. *Dose*, 5 to 20 min. rubbed with 1 fl.dr. of mucilage.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION, AND ACTION ON THE BLOOD.

Positive knowledge on these points is wanting; but the drug certainly does not derange the stomach and intestines like opium. It is never used externally. Internally the extract

forms a useful corrective of some griping purgatives, such as podophyllin or colocynth.

2. SPECIFIC ACTION AND USES.

The action of cannabis indica is ill understood. It chiefly affects the convolutions, **producing a species of intoxication**; disordered consciousness of personality, locality, and time; and exaltation of the feelings, with pleasing grandiose ideas and hallucinations. Noisy, restless delirium, with muscular excitement, or, more commonly, sleep supervenes; and therewith any pain that may be present is relieved. The heart and blood pressure appear to be first stimulated and afterwards depressed.

Cannabis indica was formerly used as a **hypnotic and anodyne**, when opium disagreed or had been taken in excess; but, from its uncertainty, it has been generally replaced by chloral. Combined with bromide of potassium, it is useful in mania. More frequently it is given as a special anodyne and antispasmodic in dysmenorrhœa, menorrhagia and hysteria. It may also be tried in neuralgia, and in spasmodic asthma (as cigarettes), when other remedies fail.

3. REMOTE LOCAL ACTION.

Nothing is definitely known respecting the excretion of cannabis indica. It increases the amount of urine, probably through the blood pressure.

Lupulus—HOP.—The dried strobiles of the female plant of Humulus lupulus. Cultivated in England.

Characters.—Strobiles of a greenish-yellow colour, with minute yellow grains (lupuline) adherent to the base of the scales. Odour, aromatic; taste, bitter.

Composition.—Hops contain an *aromatic volatile oil, valerol*, $C_6H_{10}O$, on which its smell depends; 11 per cent. of a crystalline bitter principle, *lupulinic acid*, $C_{32}H_{50}O_7$; and *tannin*.

Incompatibles.—Mineral acids and metallic salts.

Preparations.

1. Extractum Lupuli. Alcoholic and aqueous.—4 in 1. *Dose*, 5 to 15 gr.
2. Infusum Lupuli.—1 in 20. *Dose*, 1 to 2 fl.oz.
3. Tinctura Lupuli.—1 in 8. *Dose*, ½ to 2 fl.dr.

Hypnotic
anodyne.
Intoxicant.

Ritter
Ionia.
Diversity
Hymnodia

ACTION AND USES.

The action and uses of hops depend upon the presence of its two important constituents, which exert the characteristic effects of the class to which they respectively belong. The primary stimulant, and secondary sedative and soporific effects of the **aromatic** oil associated with those of alcohol, are seen in ales and beers, less distinctly in the officinal preparations. The **stomachic and tonic** effect of the **bitter** lupulinic acid is equally familiar in wholesome bitter ale. Ale is moderately laxative and **diuretic** by virtue of the essential oil.

Hops are used medicinally chiefly in the form of pure bitter ales, to produce the effects just indicated, especially to rouse and improve the appetite in convalescence and other low states of the system, and to **promote sleep.** The officinal preparations sometimes relieve the craving of alcoholism, and act as anaphrodisiacs.

CONIFERÆ.

Terebinthinæ Oleum—OIL OF TURPENTINE. —The oil distilled from the oleo-resin (turpentine), obtained from Pinus palustris, Pinus Tæda, and sometimes Pinus Pinaster.

Characters.—Limpid, colourless, with a strong peculiar odour, and a pungent and bitter taste. Sp. gr., 0·864. Mixes with other volatile and fixed oils, and dissolves resins, wax, sulphur, phosphorus, and iodine. Solubility, 1 in 10 of rectified spirit; remains transparent with chloroform.

Composition.—The oleo-resin, common turpentine, as it flows from trees, is an impure solution of *resin* in the officinal *volatile oil.* The oil of turpentine, $C_{10}H_{16}$, with the characters just described, readily absorbs oxygen, and is converted into the resin, which thus increases with the exposure of the oleo-resin to air. When the latter is distilled, the volatile oil passes over, leaving the resin behind. Oil of turpentine is isomeric with a number of volatile oils already met with in the materia medica.

Dose.—10 to 30 min.; as an anthelmintic, 2 to 4 fl.dr.

Preparations.

1. **Confectio Terebinthinæ.**—1, with Liquorice 1, and Honey 2. *Dose*, 60 to 120 gr.
2. **Enema Terebinthinæ.**—1 oz., with Mucilage of Starch 15 oz.; for one enema.

3. Linimentum Terebinthinæ.—16, with Camphor 1, and Soft Soap 2.
4. Linimentum Terebinthinæ Aceticum.—1, with Acetic Acid 1, and Liniment of Camphor 1.
5. Unguentum Terebinthinæ.—1 in $2\frac{1}{3}$.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally.—Applied to the skin or exposed mucous surfaces, turpentine is **antiseptic and disinfectant**, and produces a sense of heat and redness, followed by burning and vesication, the local circulation being stimulated, and the local nerves first irritated and then depressed. Turpentine is therefore in very extensive use as a **local stimulant and counter-irritant**: (*a*) In painful affections of a local kind, such as chronic rheumatism of muscles or joints, and neuralgia, in the form of the liniments, the resin plaster, and turpentine stupes. (*b*) In affections of deep parts, to act reflexly on the vessels and nerves; for instance, to relieve bronchitis by being rubbed on the chest, meteorism by application to the abdomen as stupes, or affections of joints by inunction over them. (*c*) As a disinfectant and stimulant it may be applied to ulcers and wounds, the Unguentum Resinæ being very useful for this purpose, whilst the pure oil may be applied to hospital gangrene. Turpentine is absorbed by the unbroken skin, and its action in meteorism may be partly accounted for in this way, as we shall see.

Internally.—Oil of turpentine with its characteristic taste, produces reflex salivation, and possibly in this way improves the digestion when given in small doses. Having reached the stomach it is, as externally, disinfectant, stimulant to the vessels, sedative to the local nerves, and reflexly stimulant, at least for a time. In a word, turpentine is a powerful *carminative*. It is but little given for this purpose, because unpleasant to the taste and often disagreeable in its own effects, and because we have abundance of other aromatic volatile oils, equally powerful, and without either of these drawbacks. See *Caryophyllum*, page 242.

Turpentine passes into the bowel, and may be found even in the colon (which may, however, *excrete* it also, as will be described). Here it acts reflexly as a **stimulant to the muscular coat**, causing contraction, expulsion of gas and fæces, and recovery of tone if it have been lost by tympanitic distension; and is also a disinfectant and vascular stimulant. In larger doses these effects proceed to purgation. It is therefore given

Antiseptic + disinfectant
Stimulant + Counter irritant
Stimulant to Muscular Coat
of Intestine
Anthelmintic
Nerve Sedative
Haemo-Static
Diuretic (Small doses).
Antidote for Phosphorus

in tympanites, either by the mouth or as the enema, especially when this is associated with constipation; and it has proved useful in some forms of diarrhœa and dysentery. It may also be advantageously added to enemata after hæmorrhage from any part, being, as we shall see, hæmostatic.

Turpentine proves to be an **anthelmintic**, and is given either by the mouth for the tape-worm, in doses of ½ to 2 fl.dr., which may certainly cause unpleasant symptoms; or as the Enema, for the thread-worm, an excellent method.

Another local application of oil of turpentine is to the respiratory organs, as an inhalation. The diluted vapour in steam should be used, or the pure vapour inhaled from a warm sponge, which may however be irritant. Turpentine enters the blood thus, but the chief action desired is a purely local one, to disinfect and stimulate the chronically inflamed or ulcerated surfaces of the lungs and bronchi, and correct the smell and irritant properties of the products. It is therefore used in gangrene of the lung, dilated bronchi, and other allied conditions.

2. Action on the Blood.

Oil of turpentine is freely absorbed by all surfaces, and enters the blood unchanged. Thus introduced, it produces none of the rapidly fatal effects which follow its injection into the veins of animals, and which are referable in part to coagulation and its results. Probably, however, even in medicinal quantities, turpentine is partially oxydised at the expense of the blood.

3. Specific Action and Uses.

Found unchanged in the tissues and organs, oil of turpentine sets up a series of symptoms, mainly depressant in their character, which follow the reflex stimulant effects already described as referable to its action on the nerves and vessels of the stomach. A full dose produces a feeling of languor, debility, nausea, dulness, sleepiness, and unsteady gait; a large dose may lead to coma. These **sedative effects on the nervous system** may account for the success of the empirical use of turpentine in painful affections such as neuralgia, especially obstinate sciatica.

At the same time the heart is disturbed by the oil, and the blood pressure decidedly falls. Here we may find the explanation, in part, of the unquestionable value of turpentine as a **hæmostatic**. Of all the means of arresting internal hæmorrhage, it frequently proves itself to be the most powerful: bleeding from the lungs, stomach, bowels, and uterus will often cease after a full dose of turpentine, when

every other drug has failed. It appears to be specially useful in intestinal hæmorrhage from typhoid ulceration. In all such cases the oil must be fearlessly exhibited, since life is at stake, a dose of ½ fl.dr. being followed every two hours by doses of 15 to 20 min.

The temperature is believed to be lowered by turpentine.

This substance is also a physiological **antidote to phosphorus**, and may be used (best in the form of the crude oil) either to prevent chronic phosphorus poisoning in workmen, or in small repeated doses in acute poisoning, after sulphate of copper. See *Phosphorus* (page 99) and *Copper* (page 65).

4. Remote Local Action and Uses.

Oil of turpentine, like the volatile oils, is excreted, mainly as such, by the cutaneous and mammary glands, by the lungs and respiratory passages, by the kidneys, and possibly by the liver, biliary mucosa, and intestines. All these organs are influenced by the oil as it passes through them. Perspiration is slightly increased, and an eruption may appear on the skin. In the bronchial walls it acts as a vascular stimulant, and disinfects both these and their products; it might therefore be a valuable drug in chronic bronchitis, dilated bronchi, and gangrene of the lungs. Its effect as it passes through the kidneys accounts for the comparatively little use that is made of it in these and other diseases. Even in moderate doses it may produce symptoms of **irritation and congestion of the renal organs**, including lumbar pain, repeated painful ineffectual attempts at micturition, a sense of heat and spasm in the perineum, frequently with hæmaturia. Whilst small doses cause diuresis, large doses may cause complete suppression. It may be occasionally used with caution in Bright's disease, and even in hæmaturia. Part of the turpentine is excreted as a fragrant violet-smelling body, and this and the unchanged portion exert a remote local effect as stimulants and disinfectants in the bladder and urethra, so that cystitis and gleet have been treated with the oil.

In passing through the biliary passages, turpentine is believed to prevent or dissolve gall stones. Its excretion by the colon probably contributes to its effect in emptying the bowel of gas and fæces.

Resina—Resin.—The residue of the distillation of the turpentines from various species of Pinus and Abies.

Characters.—Translucent, yellowish, brittle, pulverisable; fracture shining; odour and taste faintly terebinthinate. It is

easily fusible, and burns with a dense yellow flame and much smoke. It is soluble in its own weight of oil of turpentine.

Composition.—Resin consists of three resinous acids, *abietic, sylvic,* and *pimaric,* $C_{20}H_{30}O_2$; neutral resins; and a trace of *oil of turpentine.*

Preparations.

1. Emplastrum Resinæ.—1 in 9½.
2. Unguentum Resinæ.—"Basilicon." 1 in 3½.

Resin is contained in many other plasters and ointments, and in Charta Epispastica.

ACTION AND USES.

Resin is a mild **local stimulant,** either of the unbroken skin or of sores and wounds, and the Unguentum is used for this purpose. Resin is also an ingredient of many plasters, to which it gives consistence and adhesiveness.

Terebinthina Canadensis—Canada Balsam.—The turpentine obtained by incision from the stem of Abies balsamea, Balm of Gilead Fir. From Canada.

Characters.—A pale yellow ductile oleo-resin, of the consistence of thin honey, with a peculiar agreeable odour, and a slightly bitter feebly acrid taste; by exposure drying very slowly into a transparent adhesive varnish; solidifying when mixed with a sixth of its weight of magnesia.

Composition.—Canada "balsam" contains 17 per cent. of a *volatile oil.* The *resin* is dissolved in this.

Dose.—20 to 30 gr.

Canada Balsam is contained in Charta Epispastica and Collodium Flexile.

ACTION AND USES.

Canada balsam is chiefly **used for its physical properties.** It has been given internally to produce the effects of oil of turpentine in a milder form.

Laricis Cortex—Larch Bark.—The bark, deprived of its outer layer, of Larix europæa, *D.C.,* Abies Larix *Rich.,* the common Larch.

Characters.—In flat pieces; the inner surface yellow and fibrous, outer reddish-brown under a greyish epidermis. Has a faint odour of turpentine.

Substance resembling Larch Bark: Red Cinchona Bark, known by bitter taste.

Composition.—Larch bark yields an oleo-resin, *Venetian turpentine*, brownish-yellow, tenacious, with an aromatic bitter taste and a pleasant nutmeg-like odour. In its general characters and properties it closely resembles ordinary crude turpentine.

Preparation.

Tinctura Laricis.—1 in 8. *Dose*, 20 to 30 min.

ACTION AND USES.

Larch closely resembles turpentine in its action, but is more pleasant. It is used (but rarely) in the same class of cases.

Thus Americanum—Common Frankincense. The concrete turpentine of Pinus Tæda, the Frankincense Pine, and Pinus palustris, the Swamp Pine. From the southern states of North America.

Characters.—A softish, bright-yellow, opaque solid, resinous but tough, having the odour of American turpentine.

Composition.—This is apparently the same as the composition of common resin.

Thus Americanum is contained in Emplastrum Picis.

ACTION AND USES.

Frankincense has the same action and uses as resin and its allies just described.

Pix Burgundica — Burgundy Pitch. — A resinous exudation from the stem of the Spruce Fir, Abies excelsa. Melted and strained; imported from Germany.

Characters.—Hard and brittle, yet gradually taking the form of the vessel in which it is kept; opaque, varying in colour, but generally dull reddish-brown; of a peculiar somewhat empyreumatic perfumed odour, and aromatic taste,

Vasculaire stimulant.
Astringent
Désinfectant
Désodorant

without bitterness; free from vesicles; gives off no water when heated.

Composition.—Burgundy pitch consists of various *resinous acids*, as in ordinary resin, combined with *oil of turpentine*. A special *volatile oil* imparts to it its odour.

Preparation.

Emplastrum Picis,—1 in 2.

Pix Burgundica is also contained in Emplastrum Ferri.

ACTION AND USES.

Burgundy pitch has a **mildly stimulant** action on the skin, and is used only for making plasters.

Pix Liquida—TAR.—A bituminous liquid obtained from the wood of Pinus sylvestris and other pines by destructive distillation.

Characters.—Thick, viscid, brownish-black, of a well-known peculiar aromatic odour. Water agitated with it acquires a pale-brown colour, sharp empyreumatic taste, and acid reaction.

Composition.—Tar is a variable mixture of *creasote*, *phenol* (carbolic acid), *toluol*, *xylol*, *acetic acid*, *turpentine*, *resin*, etc.

Dose.—20 to 60 min. in pill.

Preparation.

Unguentum Picis Liquidæ.—5 in 7.

ACTION AND USES.

Tar, being a compound of creasote, carbolic acid, and other substances, possesses an action very similar to the first two of these bodies, to which the student is referred. Its exact composition being variable, the action of tar is uncertain; and internally it is now but little employed.

Externally, it is more valuable than either of its important constituents, as a **vascular stimulant and alterative** in dry skin diseases, such as chronic eczema and psoriasis; and as a nervous sedative in prurigo and other kinds of itching.

Internally, tar may be given in pills, in capsules, or as tar-water, made by shaking up a pint of tar with half-a-gallon of water, and decanting after settlement—a very popular panacea a hundred years ago. Tar may still be used as a disinfectant in the stomach and bowels (see *Creasotum*, page 172),

and as a **remote disinfectant and deodorant** in foul discharges from the bronchi and lungs, through which it is probably in part excreted.

Juniperi Oleum—Oil of Juniper.—The oil distilled in Britain from the unripe fruit of Juniperus communis.

Characters of the fruit.—The size of a large pea, of a blackish-purple colour, covered by a glaucous bloom; marked with a tri-radiate groove. Taste sweetish, terebinthinate; odour agreeable and balsamic.

Characters of the oil.—Colourless, or pale greenish-yellow, of a sweetish odour and warm aromatic taste.

Composition.—Juniper berries contain the officinal *volatile oil*, a quantity of *grape sugar*, *resin*, and colouring matter. The oil is a complex compound of terpenes and camphors.

Dose.—1 to 3 min.

Preparation.

Spiritus Juniperi.—1 in 50. *Dose*, 30 to 60 min.

Spiritus Juniperi is contained in Mistura Creasoti.

ACTION AND USES.

The physiological action of juniper naturally resembles closely that of turpentine, but its remote local stimulant action on the kidney is peculiarly marked, whilst this drug is neither disagreeable nor dangerously powerful like the other. Thus it acts as a **stomachic, stimulant, and anti-spasmodic**; is absorbed into the blood; is excreted in the urine, to which it imparts a violet odour; acts as a **direct diuretic**, increasing both solids and water; and in large doses causes strangury and renal inflammation.

Juniper is used almost entirely as a diuretic in dropsy not dependent on acute renal disease, *i.e.* in cardiac and hepatic dropsy, and in some cases of chronic Bright's disease. It is best given combined with saline diuretics, or in the form of "Hollands."

Sabinæ Cacumina—Savin Tops.—The fresh and dried tops of Juniperus Sabina. Collected in spring, from plants cultivated in Britain.

Characters.—Twigs, densely covered with minute imbri-

cated appressed leaves in four rows; odour strong, peculiar, and unpleasant; taste acrid, bitter, resinous, and disagreeable.

Composition.—Savin contains the officinal *volatile oil*, isomeric with turpentine, $C_{10}H_{16}$, colourless or pale yellow, limpid, with an unpleasant odour and bitter acrid taste.

Preparations.

Dose, in powder.—4 to 10 gr.

1. Oleum Sabinæ.—Distilled in Britain from *fresh* savin. *Dose*, 1 to 5 min.

2. Tinctura Sabinæ.—1 of *dried* tops in 8. *Dose*, 15 to 30 min.

3. Unguentum Sabinæ.—1 of *fresh* tops in $3\frac{2}{3}$.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally.—The action of savin closely resembles that of oil of turpentine, but it is more **irritant, causing vesication** of the unbroken skin, and a profuse flow of pus from a wounded surface. It was formerly used to promote the discharge from blisters or issues, a practice now seldom resorted to. It rapidly dispels small venereal warts or condylomata.

Internally.—Savin is a powerful gastro-intestinal irritant, to be avoided, or only used with great caution.

2. ACTION IN THE BLOOD; SPECIFIC AND REMOTE LOCAL ACTION AND USES.

Oil of savin is absorbed, carried through the organs, and excreted like oil of turpentine. It thus acts as a remote local **irritant to the kidneys** and mucous membranes, especially those of the genital part, causing hyperæmia of the ovaries and uterus, increased menstrual activity, and contraction of the pregnant uterus. It has been used as an **emmenagogue**, but requires the exercise of great care. More frequently it is given as an ecbolic for criminal purposes, and then often proves fatal as a gastro-intestinal irritant.

ZINGIBERACEÆ.

Zingiber—GINGER.—The scraped and dried rhizome of Zingiber officinale. From plants cultivated in the West Indies, India, and other countries.

Characters.—Irregular lobed decorticated pieces, three or four inches long, subcompressed, yellowish-white but not

chalky on the surface, with a short mealy fracture, hot taste, and agreeable aroma. Powder yellowish-white.

Substance resembling Ginger: Turmeric, known by colour.

Composition.—Ginger contains an *aromatic volatile oil*, the exact composition of which is uncertain.

Dose.—10 to 20 gr.

Preparations.

1. Tinctura Zingiberis.—1 in 8. *Dose*, 10 to 30 min.
2. Tinctura Zingiberis Fortior.—"Essence of Ginger." 1 in 2. *Dose*, 5 to 20 min.

From this is prepared:

Syrupus Zingiberis.—1 of Strong Tincture in 26. *Dose*, 1 to 4 fl.dr.

Ginger is also contained in a variety of powders, and other preparations of more important drugs.

ACTION AND USES.

Ginger acts and is used like other substances containing aromatic volatile oils. It is one of the most generally employed of all carminatives.

Curcuma—Turmeric.—The rhizome of Curcuma longa.

Composition.—Turmeric contains a yellow crystalline *colouring matter*, a *volatile oil*, *resin*, and *starch*.

Preparations.

1. Turmeric Tincture.—1 in 6.
2. Turmeric Paper.

USE.

Turmeric paper is used pharmaceutically as a test for alkalies, which change the yellow to a reddish-brown. As a condiment it is a constituent of curry powder.

Cardamomum—Cardamoms.—The dried capsules of the Malabar Cardamom, Elettaria Cardamomum. Cultivated in Malabar. The seeds are best kept in their pericarps, from which they should be separated when required for use, the pericarpial coats being rejected.

Characters.—Seeds obtusely angular, corrugated, reddish-brown, internally white, with a warm aromatic agreeable taste and odour, contained in ovate-oblong triangular pale-brown coriaceous ribbed pericarps.

Composition.—The active principle of cardamoms is an *aromatic oil*, $C_{10}H_{16}$, isomeric with turpentine.

Preparation.

Tinctura Cardamomi Composita.—1 in 80, coloured with Cochineal. *Dose*, ½ to 2 fl.dr.

Tinctura Cardamomi Composita is contained in Decoctum Aloes Compositum; Mistura Ferri Aromatica; Mistura Sennæ Composita; and Tinctura Chloroformi Composita.

Cardamoms are also contained in many preparations as a flavouring agent.

ACTION AND USES.

Cardamoms serve as a highly agreeable, slightly stimulant, flavouring and carminative agent allied to the peppers.

IRIDACEÆ.

Crocus—SAFFRON.—The dried stigma, and part of the style, of Crocus sativus. Imported from Spain, France, and Italy.

Characters.—Thread-like styles, each terminated by three long orange-brown stigmas, broadest at the summit. Has a powerful aromatic odour. Rubbed on the wet finger it leaves an intense orange-yellow tint. When pressed between folds of white filtering paper it leaves no oily stain.

Composition.—Saffron contains *saffranin* or *polychroite*, an orange-red glucoside, which yields a red colouring matter, *crocin;* and a *volatile oil* allied to turpentine.

Impurities.—Marigold and sunflower petals.

Preparation.

Tinctura Croci.—1 in 20. *Dose*, ½ to 2 fl.dr.

Saffron is also extensively used as a colouring agent.

ACTION AND USES.

Crocus is used only to colour officinal preparations.

Iris—BLUE FLAG. (*Not Officinal.*)—The rhizome and rootlets of Iris versicolor.

Characters.—Rhizome 2 to 4 inches long, jointed, terminated by a scar, annulated from the leaf-sheaths, grey-brown. Rootlets long and simple; odour slight; taste acrid and nauseous.

Composition.—A resinoid substance, *iridin*, has been obtained from the root, the exact composition of which appears to be undetermined.

Non-officinal Preparations.

Extractum Iridis (U. S. P.).—*Dose*, 1 to 5 gr.
Extractum Iridis Fluidum (U. S. P.).—*Dose*, 5 to 60 min.
Iridin.—A powdered extractive; dark-brown; bitter, nauseous, and acrid to the taste. *Dose*, 1 to 5 gr.

ACTION AND USES.

Iridin is a powerful **hepatic stimulant or direct cholagogue, and cathartic**; possibly also diuretic. It is a useful purgative in disorder of the liver and duodenum, whether given alone or combined with other remedies.

SMILACEÆ.

Sarsæ Radix—JAMAICA SARSAPARILLA.—The dried root of Smilax officinalis. Native of Central America; imported from Jamaica.

Characters.—Roots not thicker than a goose-quill, generally many feet in length, reddish-brown, covered with rootlets, and folded in bundles about eighteen inches long; scentless; taste mucilaginous, feebly bitter, faintly acrid.

Substances resembling Sarsa: Senega, which is twisted; Hemidesmus, cracked transversely.

Composition.—Sarsaparilla contains a small quantity of *volatile oil*, a colourless crystalline neutral principle, *smilacin*, $C_{18}H_{30}O_6$, *resin*, *starch*, *mucilage*, etc.

Impurities.—Inferior kinds, and Dulcamara.

Preparations.

1. **Decoctum Sarsæ.**—1 in 8. *Dose*, 2 to 10 fl.oz.
2. **Decoctum Sarsæ Compositum.**—Sarsaparilla, 2½ oz.; Sassafras, ¼ oz.; Guaiacum Wood, ¼ oz.; Liquorice, ¼ oz.; Mezereon, 60 gr.; Water, 30 oz. *Dose*, 2 to 10 fl.oz.
3. **Extractum Sarsæ Liquidum.**—2 in 1. *Dose*, 1 to 4 fl.dr.

Hepatic Stimulant.
Purgative

Alienativo.

ACTION AND USES.

The physiological action of sarsaparilla is unknown, the diaphoretic and diuretic effects which follow large draughts of its fluid preparations being generally referred to the water alone. It is tolerated in very large doses by the stomach. Smilacin is excreted in the urine.

Great diversity of opinion exists as to the value of sarsaparilla therapeutically. Whilst the pharmacological evidence is negative, as we have seen, the clinical evidence is entirely discordant, some authorities considering it an **alterative** drug of extraordinary value in syphilis, chronic skin-disease, and rheumatism, others entirely worthless. On the one hand, many cases of these diseases are greatly benefited by careful treatment, with rest, good food, baths, and abundance of warm fluids alone; and, on the other hand, sarsaparilla is almost always combined with other drugs, including guaiacum, sassafras, mezereon, iodide of potassium, and mercury. If given, it is indicated in old standing cases of syphilis in feeble subjects, who have already suffered from the abuse of mercury or iodine, and the compound decoction should be freely used.

LILIACEÆ.

Scilla—Squill.—The sliced and dried bulb of Urginea Scilla. From the Mediterranean coasts.

Characters.—Bulb pear-shaped, weighing from half a pound to ten pounds; outer scales membranous, brownish-red or white; inner scales thick, whitish, fleshy, juicy; taste mucilaginous, intensely and disagreeably bitter, somewhat acrid. The dried slices are white or yellowish-white, slightly translucent, scentless, disagreeably bitter; brittle, and easily pulverisable if very dry, but if exposed readily recovering moisture and flexibility.

Substance resembling Scilla: Tragacanth, which is more horny.

Composition.—Squill contains, besides the usual constituents of plants, an active bitter glucoside *scillaïn*. Another substance called *scillitin* is really but an extract of variable strength and properties.

Dose, in powder.—1 to 3 gr.

Preparations.

1. **Acetum Scillæ.**—1 in 8. *Dose*, 15 to 40 min.

From Acetum Scillæ are prepared:

a. Oxymel Scillæ.—5 of the Acetum with 8 of Honey. *Dose*, ½ to 1 fl.dr.

b. Syrupus Scillæ.—1 of the Acetum with 2 of Sugar. *Dose*, ½ to 1 fl.dr.

2. **Pilula Scillæ Composita.**—Squill, 1¼; Ginger, 1; Ammoniacum, 1; Hard Soap, 1; Treacle, 2. *Dose*, 5 to 10 gr.

3. **Pilula Ipecacuanhæ cum Scillâ.**—1 in 7. *Dose*, 5 to 10 gr.

4. **Tinctura Scillæ.**—1 in 8. *Dose*, 15 to 30 min.

ACTION AND USES.

The action of this important drug so **closely resembles that of digitalis**, that it is unnecessary to give it in detail. The student is therefore referred to all that is said respecting digitalis (page 310), and will apply it to squill. Briefly, it produces the same increase of vigour and diminution of frequency of the cardiac action; the same contraction of the peripheral vessels and rise of pressure, followed by relaxation commencing in the renal arterioles; and therefore the same kind of diuresis.

Squill is employed in the same class of cases as digitalis, most frequently in combination with this drug, diuretics being most active when given together. It must not however be given continuously, but with occasional intermissions, when it is more actively diuretic and less irritant to the stomach and kidney.

Two properties, however, distinguish squill from digitalis, and have to be carefully observed:

1. Squill is much **more irritant to the stomach and intestines than digitalis**, causing vomiting and purging in full doses, and very liable to produce dyspepsia even in medicinal quantities. It is thus a drug which must often be withheld when most clearly indicated, one of the first principles of therapeutics being never to derange the stomach.

2. Squill is a **powerful expectorant.** This action is probably a remote local one, the scillaïn stimulating the bronchial wall during excretion, as it irritates the gastro-intestinal wall during absorption, in this respect resembling ipecacuanha (emetin) and senegin. It is much employed as a stimulant expectorant in bronchitis, when the indication is to increase the local circulation and secretion, and accelerate the removal of the products. It is therefore suitable for chronic cases, especially if the right ventricle be secondarily affected, as it strengthens the heart and promotes diuresis. It is contra-indicated in acute bronchitis, in interesting contrast to ipecacuanha

Expectorant.
Irritant to Stomach & Intestines
causing vomiting.
Slows & strengthens the heart.
Raises blood pressure.
Diuretic.

(see *Ipecacuanha*, page 267); and must also be withheld when the stomach is feeble or deranged, as in phthisis. The routine use of squill for all kinds of cough is to be deprecated.

Convallaria.—The entire plant of Convallaria majalis, the Lily of the Valley. (*Not Officinal.*)

Characters.—Leaves radical, usually two, oblong, tapering at both ends, 4 to 6 inches long. Flower stem leafless, radical, shorter than the leaves. Flowers drooping, bell-shaped, in a loose raceme.

Composition.—Lily of the valley contains two glucosides, *convallarin*, crystalline, insoluble in water; and *convallamarin*, white, amorphous, bitter, and soluble in water and in spirit.

Non-officinal Preparations.

Extract of Convallaria.—Aqueous. *Dose*, 2 to 8 gr.
Convallamarin.—*Dose*, ½ to 2 gr.
An Infusion may also be used.

ACTION AND USES.

Convallaria has an action very similar to that of squill and digitalis, the active principles of which are also glucosides. In medicinal doses it **slows and strengthens the heart, raises the blood pressure, and is a decided diuretic.** It has proved remarkably useful in some cases of cardiac dropsy. At the same time it is a gastro-intestinal irritant like squill, this effect being due to the convallarin, whilst the convallamarin acts on the circulation. Aqueous preparations, or the pure convallamarin, should therefore be given.

Aloe Barbadensis—BARBADOES ALOES.—The inspissated juice of the leaf of Aloe vulgaris. Imported from Barbadoes.

Characters.—In yellowish-brown or dark-brown opaque masses; breaks with a dull conchoidal fracture; has a bitter nauseous taste, and a strong disagreeable odour; dissolves almost entirely in proof spirit, and during solution exhibits microscopically numerous crystals. Usually imported in gourds.

Substances resembling Aloes: Guaiacum, Scammony, and Catechu, all destitute of bitter taste.

Aloe Socotrina—Socotrine Aloes.—The inspissated juice of the leaf of one or more undetermined

species of Aloe. Produced chiefly in Socotra, and shipped to Europe by way of Bombay.

Characters.—In reddish-brown masses, opaque, or translucent at the edges; breaks with an irregular or smooth and resinous fracture; has a bitter nauseous taste, and a strong but fragrant odour; dissolves entirely in proof spirit, and during solution exhibits microscopically numerous minute crystals.

Composition.—Aloes contains: (1) *Aloin*, $C_{17}H_{18}O_7$, an inodorous body, with a taste at first sweet, afterwards intensely bitter; partly crystallising in small colourless needles, partly amorphous and then called *aloëtin;* readily soluble in hot water, the heat converting the crystalline into the amorphous form. (2) *Aloe resin*, a brown translucent body, insoluble in water. (3) *Gallic acid*, in small quantity. (4) A *volatile oil*, the source of the odour of aloes. (5) Various less important bodies.

Dose.—Of either kind of aloes, 2 to 6 gr.

Preparations.

A. *Of Aloe Barbadensis:*

1. Enema Aloes.—40 gr.; Carbonate of Potash, 15 gr.; Mucilage of Starch, 10 fl.oz. For one enema.
2. Extractum Aloes Barbadensis.—Aqueous. 1¼ in 1. *Dose*, ½ to 2 gr.
3. Pilula Aloes Barbadensis.—Aloes, 2; Hard Soap, 1; Oil of Caraway, ½; Confection of Roses, 1. *Dose*, 4 to 8 gr.
4. Pilula Aloes et Ferri.—Aloes, 2; Sulphate of Iron, 1½; Compound Powder of Cinnamon, 3; Confection of Roses, 4. *Dose*, 5 to 10 gr.

Barbadoes Aloes is also an important ingredient of Pilula Cambogiæ Composita, Pilula Colocynthidis Composita, and Pilula Colocynthidis et Hyoscyami.

B. *Of Aloe Socotrina:*

1. Enema Aloes.—Prepared as from Barbadoes Aloes.
2. Extractum Aloes Socotrinæ.—Aqueous. 2 in 1. *Dose*, 1½ to 3 gr.

From Extractum Aloes Socotrinæ is prepared:

Decoctum Aloes Compositum.—Extract, 120 gr.; Myrrh, 90 gr.; Saffron, 90 gr.; Carbonate of Potash, 60 gr.; Extract of Liquorice, 1 oz.; Compound Tincture of Cardamoms, 8 fl.oz.; and Water to make 30 oz. 4 gr. in 1 fl.oz. *Dose*, ½ to 2 fl.oz.

Extractum Aloes Socotrinæ is also an ingredient of Extractum Colocynthidis Compositum. 1 in 2¼ nearly.

Bitter
Purgative
Increases uterine activity
Anthelmintic - Emma,

3. Pilula Aloes Socotrinæ.—1 in 2. *Dose*, 5 to 10 gr.
4. Pilula Aloes et Assafœtidæ.—Equal parts of Aloes, Assafœtida, Hard Soap, and Confection of Roses. 1 in 4. *Dose*, 5 to 10 gr.
5. Pilula Aloes et Myrrhæ.—Aloes, 2; Myrrh, 1; Saffron, ½; Confection of Roses, 2½. 1 in 3. *Dose*, 5 to 10 gr.
6. Tinctura Aloes.—1 in 40. *Dose*, 1 to 2 fl.dr.
7. Vinum Aloes.—Nearly 2 gr. in 1 fl.dr. *Dose*, 1 to 2 fl.dr.

Aloes Socotrina is also an important ingredient of Pilula Rhei Composita, 1 in 6; and Tinctura Benzoini Composita, 8 gr. to 1 fl.oz.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Aloes acts upon the stomach and intestines as a **bitter and purgative.** The former effect is fully described under *Calumbæ Radix*, page 181. As a purgative, aloes is peculiar in **acting chiefly upon the colon.** Ten to fifteen hours or even more after an ordinary dose, rarely sooner, a soft formed or lightly relaxed motion is passed. Very large doses may not act more quickly, but much more violently, with pain, straining, and possibly bleeding from the rectum. Aloes is thus the slowest of all purgatives. The presence of bile is believed to be required to insure the action of the purgative aloin, and the drug is, in turn, a stimulant of the biliary flow. The pelvic circulation generally, as well as that of the rectum, is excited by aloes, which may cause hæmorrhoids and hæmorrhage from the bowel, **increased uterine activity,** menstruation, possibly menorrhagia, and even abortion if given in large doses, in certain subjects, or repeatedly.

Aloes is used as one of our most valuable purgatives in suitable cases. It is especially indicated in habitual constipation due to languor of the colon, with low atonic dyspepsia and hypochondriacal despondent feelings. It improves instead of deranging digestion, and gains instead of losing its activity by repetition; its laxative effect is of a natural character, if its griping action be covered by carminatives as in most of the officinal preparations. It must, however, be avoided in irritable states of the rectum, hæmorrhoids, menorrhagia, and pregnancy, unless given with care. Aloes is an ingredient of almost all the compound pills in ordinary use for habitual constipation, *e.g.* of rhubarb, colocynth, and gamboge; and the extract is also given with extract of belladonna, nux vomica, sulphate of iron, or quinia, as a dinner-pill. The compound decoction is

perhaps the best preparation of the drug, being particularly valuable in the constipation of children with hard motions, vermes, indigestion, acidity, and derangement of the general health.

The action of aloes on the pelvic circulation constitutes it a uterine stimulant, and it is given with success as the Aloes and Myrrh Pill in the amenorrhœa of young women, so often associated with chronic constipation and dyspepsia. The Aloes and Iron Pill is perhaps the most valuable of all remedies in the anæmia, amenorrhœa, and constipation of girls at and after puberty. Enema Aloes is anthelmintic.

2. ACTION IN THE BLOOD; SPECIFIC, AND REMOTE LOCAL ACTION.

Aloin enters the blood and tissues, and is excreted at least in the milk.

MELANTHACEÆ.

Veratri Viridis Radix — GREEN HELLEBORE ROOT.—The dried rhizome of Veratrum viride. Collected in autumn in the United States and Canada.

Characters.—Slices, fragments, or conical truncated entire pieces, earthy, black outside, light within; with numerous yellowish radicles attached to it. When dry it is inodorous. Taste at first sweet, then bitter, followed by a persistent acrid burning sensation in the mouth.

Substances resembling Veratrum Viride: Valerian, Serpentary, and Arnica (q.v.). Veratrum has thicker rootlets.

Composition.—Veratrum viride contains a mixture of alkaloids, which have been variously separated and named by different pharmacologists, *veratria*, *veratroidin*, and *jervin*.

Preparation.

Tinctura Veratri Viridis,—1 in 5. *Dose*, 5 to 20 min.

Sabadilla — CEVADILLA. — The dried fruit of Asagræa officinalis. Imported from Mexico.

Characters.—Fruit about half an inch long, consisting of three light brown papyraceous follicles, each containing from one to three seeds, which are about a quarter of an inch long, blackish-brown, shining, slightly winged, possessing an intensely acrid bitter taste.

Composition.—The active constituent of sabadilla is *veratria*.

Servia + Varadia (Frasen)

Debilitant to Nerves + Heart.
Antihysteric
Lengthens the contractions of
Muscles + the Heart.

From Sabadilla is made:

Veratria, $C_{32}H_{52}N_2O_8$.—An alkaloid obtained from Cevadilla; not quite pure.

Source.—Obtained from Cevadilla by (1) making and concentrating a tincture of the seeds; (2) pouring into water to precipitate the albumen, and filtering; (3) precipitating crude veratria from the filtrate by NH_4O, and washing; (4) purifying by solution in HCl, digestion with charcoal, reprecipitation with NH_4O, filtration, washing, and drying.

Characters.—Pale grey, amorphous, odourless, but very irritant to nostrils; strongly and persistently bitter, and acrid; insoluble in water, soluble in spirit.

Dose, $\frac{1}{10}$ to $\frac{1}{15}$ gr., carefully divided in pill.

Preparation.

Unguentum Veratriæ.—8 gr. to 1 oz. Lard, with Olive Oil ½ fl.dr.

ACTION AND USES.

1. LOCAL ACTION AND USES.

Externally, green hellebore and veratria are first powerfully irritant and then depressant to the nerves and vessels, causing pricking, burning sensations, and redness of the skin, followed by loss of sensibility and vesication. Unguentum Veratriæ is therefore applied to relieve neuralgic and rheumatic pains, but the alkaloid is absorbed by the unbroken skin, and may produce its powerful specific effects.

Inhaled or sniffed into the nose, these substances cause violent sneezing and cough, manifestly from irritation of the nerves. No use is made of this property.

Internally, reflex salivation, dysphagia, epigastric heat and pain, vomiting, and diarrhœa, indicate the irritant effect of veratrum viride and veratria on the alimentary canal. They are never given as emetics.

2. ACTION ON THE BLOOD.

Veratria enters the blood rapidly from the skin or mucous surfaces. Leucocytes (out of the body) are paralysed or killed by dilute solutions of the alkaloid.

3. SPECIFIC ACTION.

Veratria may be found in the various organs after administration. Full doses produce, in addition to the painful vomiting of local origin, great muscular prostration, faintness,

and finally collapse, preceded and accompanied by a slow feeble or irregular pulse, feeble respiration, cold sweats, fall of temperature, occasional muscular twitching and creeping, and itching sensations on the skin. It has now been proved that these phenomena are not referable to the *cerebrum*, which remains unaffected, with perfect consciousness, nor to the motor centres of the *cord* or *motor* nerves, all of which are but slightly depressed. **The muscles are the organs attacked by veratria,** which produces a highly remarkable lengthening of the contraction, the descending portion of the muscle curve (phase of relaxation) being fifty times its ordinary length. Therewith the force of the contraction is increased. These two effects on the muscle contraction are so marked that the muscle appears to be in a state of tetanus, but the curve is really a single contraction, and not compound or a fusion of closely repeated simple spasms. Larger doses cause weakness of the muscles and finally paralysis.

The heart, after primary acceleration, is affected just like the voluntary muscles, its contractions becoming greatly lengthened, and thus its **frequency reduced** (even by 20 to 60 beats per minute in fever), long pauses occurring at the end of systole. Irregularity, acceleration with feebleness, and finally paralysis are the result of larger doses. The *blood pressure* rises at first, falls during the stage of infrequency, and is then dangerously lowered. The primary stimulation of the heart and vessels, and part of the succeeding depression, occur through the centres in the medulla.

Respiration is first accelerated, then slowed, and finally arrested through the centre, the muscles, and the pulmonary vagus; the movements exhibiting expiratory pauses and irregularity.

The fall of *temperature*, which may amount to several degrees in fever, appears to be referable to the circulatory failure.

4. SPECIFIC USES.

The specific uses of veratria depend on its **depressing action on the heart, vessels, and body temperature**; that is, it is a powerful antipyretic. It has been recommended for the same conditions as aconite, namely, acute febrile processes in strong subjects, such as sthenic pneumonia and acute rheumatism. If it be considered safe and desirable to treat such cases with powerfully depressant measures, veratria may be used; but in England, at least, the opposite line of treatment is generally followed, and every lowering influence on the heart carefully avoided. In aneurism and in hæmorrhage, where the blood

pressure has to be reduced, veratria cautiously given, or the Tinctura Veratri Viridis, may be of much service.

5. REMOTE LOCAL ACTION.

Veratria quickly appears in the urine, being excreted by the kidney.

Colchici Cormus— COLCHICUM CORM. — The fresh corm of Colchicum autumnale ; collected about the end of June ; and the same stripped of its coats, sliced transversely, and dried at a temperature not exceeding 150°.

Characters.—Fresh corm about the size of a chestnut, flattened where it has an undeveloped bud ; furnished with an outer brown and an inner yellow coat ; internally white, solid and fleshy ; yielding when cut a milky acrid and bitter juice. Dried slices about a line thick, moderately indented on one, rarely on both sides, firm, flat, whitish, amylaceous.

Substances somewhat resembling Colchicum : Tragacanth and Squill, which have different texture, and are not kidney-shaped.

Dose.—2 to 8 gr. in powder.

Colchici Semina— COLCHICUM SEEDS. — The fully ripe seeds of Colchicum autumnale.

Characters.—About the size of white mustard seed, very hard, and of a reddish-brown colour.

Substance resembling Colchicum Seeds : Black Mustard, which is smaller.

Composition. — Colchicum contains an active principle, *colchicin*, $C_{17}H_{19}NO_6$, an amorphous, yellowish, bitter alkaloid ; with tannic and gallic acids, starch, sugar, gum, etc.

Preparations.

A. *Of Colchici Cormus :*

1. **Extractum Colchici.**—25 in 1. The expressed juice of *fresh* Colchicum Corms, decanted from deposit ; heated to 212° Fahr. to coagulate albumen ; strained ; and evaporated. *Dose*, 1 to 3 gr.

2. **Extractum Colchici Aceticum.**—18 in 1. Made like the simple extract, Acetic Acid being first added to the crushed corms. *Dose*, ½ to 2 gr.

3. **Vinum Colchici.**—1 *dried* in 5. *Dose*, 10 to 30 min.

B. *Of Colchici Semina :*

Tinctura Colchici Seminum.—1 in 8. *Dose*, 10 to 30 min.

ACTION AND USES.

The physiological action of colchicum is imperfectly understood, and affords but a partial explanation of its empirical use.

Given *internally* it is a **gastro-intestinal irritant**, acting as an emetic and purgative in full doses, the stools containing a decided increase of bile, partly referable to a direct cholagogue effect of the drug. Colchicin appears to enter the blood and tissues, and here acts chiefly upon the central nervous system. The convolutions and spinal cord are depressed, large doses causing loss of sensibility and consciousness, and diminished reflex excitability. The peripheral sensory nerves are also paralysed, but the motor nerves and muscles remain unaffected. The respiratory centre is lowered in activity, and death occurs by asphyxia. The heart is weakened, the pulse even becoming intermittent; but this effect is believed to be entirely secondary to the disturbance of the respiration. The kidneys are hyperæmic, and the amount of urine diminished; the uric acid and probably the urea are reduced in quantity. The **skin perspires** more freely.

Colchicum is chiefly used to relieve the pain and inflammation, and shorten the duration, of **acute gout**, for which purpose it is usually given in doses short of producing the above physiological effects, so that the mode of its action is quite obscure. It is most successful in first attacks in young robust subjects; less useful, and to be used with caution, in the chronic gout of old weakly individuals; and occasionally it completely fails to afford any relief. It is generally prescribed with alkaline purgative salines. In some acute gouty affections of other parts than the joints, such as bronchitis, hepatic congestion, neuralgia, and urethritis, colchicum occasionally relieves. It is worse than useless in rheumatism. The extract may be added to purgative pills as a cholagogue.

PALMACEÆ.

Areca — Areca Nut. — The seed of Areca Catechu, the Betel Nut Tree. Imported from the East Indies.

Characters.—The nuts are about the size of a nutmeg, but less wrinkled and more globular, and not aromatic; reddish-brown externally, having a flattened base and somewhat conical apex. The interior is hard, dark brown, finely marbled with white. Inodorous, with astringent taste.

Emetic.
Purgative
Diaphoretic.

Scudamore's prescription for Gout.

Tinctura Colchici.	Min XV.
Magnesiae Carbon.	Gr. VI
Magnesiae Sulph.	Gr iii
Aqua Menth. Pip. ad	℥i

Composition.—Areca contains *catechu, tannic and gallic acids, areca-red, gum,* and *oily matter.*

Dose.—½ to ¾ oz.

ACTION AND USES.

Areca nut is **astringent and anthelmintic,** and has been used in diarrhœa and helminthiasis. It is rarely given.

GRAMINACEÆ.

Farina Tritici—WHEATEN FLOUR.—The grain of Wheat, Triticum vulgare, ground and sifted.

Characters.—Familiar.

Composition.—Flour consists chiefly of *gluten* and *starch,* with gum, sugar, mucilage, and water.

From Farina Tritici is made:

Mica Panis.—Crumb of Bread.

Mica Panis is contained in Cataplasma Carbonis.

Farina Tritici is also contained in Cataplasma Fermenti.

Amylum—STARCH. $C_6H_{10}O_5$. — The Starch procured from the seeds of common wheat, Triticum vulgare.

Characters and tests.—In white columnar masses. When rubbed in a Wedgwood mortar with a little cold distilled water, it is neither acid nor alkaline to test-paper, and the filtered liquid does not become blue on the addition of solution of iodine. Mixed with boiling water and cooled, it gives a deep blue colour with iodine.

Preparations.

1. **Glycerinum Amyli.**—1 part to 8 by measure; made by heating the mixture to 240° ; a jelly-like preparation.
2. **Mucilago Amyli.**—1 in 40.

Amylum is also contained in Pulvis Tragacanthæ Compositus (1 in 6).

ACTION AND USES.

Starch is a **nutritive** material of the first order, but is introduced into the Pharmacopœia for medicinal and pharmaceutical purposes only. *Externally* it is **protective and absorbent,**

in the form of "dusting powder" for delicate or diseased conditions of the skin. The glycerinum is an excellent basis for ointments. *Internally* the mucilage is the **vehicle** of all the officinal Enemata, except those of tobacco and assafœtida. It is also an **antidote** in poisoning by iodine, but must be followed by an emetic.

Hordeum Decorticatum—Pearl Barley.—The husked seeds of Hordeum distichon. Cultivated in Britain.

Characters.—White, rounded, retaining a trace of the longitudinal furrow.

Composition.—Barley consists of *starch*, *gluten*, *sugar*, *gum*, etc.

Preparation.

Decoctum Hordei. "Barley Water."—1 to 15 of water.

ACTION AND USES.

Barley water is **nutritive and demulcent**, and is chiefly used in inflammatory affections of the throat, and respiratory and urinary organs.

Malt Extract—Maltine. (*Not Officinal.*)—A syrupy yellowish-brown fluid, with a sweet taste; made by acting on malt, or a mixture of malt and flour, by water, at a temperature not exceeding 124° Fahr.

Composition.—Malt extract consists chiefly of *dextrin* and *maltose*. Good specimens have active diastatic properties, *i.e.* will convert several times their bulk of starch into sugar.

Dose.—1 to 4 dr.

ACTION AND USES.

Malt extract is, both directly and indirectly, **nutritive**, containing, as it does, not only food elements, but also active diastase, which converts the starch of bread and other farinas into sugar. It is used in wasting diseases. As diastase is only active in alkaline fluids, it must be given not less than two hours after a meal, when the acid of the stomach is exhausted. Or it may be mixed with warm food a short time before the

A.P. Ergotina & Ecbolina got from Ergotine the watery Extract of Ergot

latter is taken. Maltose is a form of sugar which does not ferment, and will not give rise to acidity and dyspepsia.

Ergota—ERGOT.—The sclerotium (compact mycelium or spawn) of Claviceps purpurea, produced within the paleæ of the common Rye, Secale cereale.

Characters.—Subtriangular, curved, with a longitudinal furrow on the concave side, obtuse at the ends; from one-third of an inch to an inch and a half in length; of a violet-brown colour on the surface, pinkish within; solid, frangible, fracture short; odour faintly marked, but strong if the powder be triturated with solution of potash.

Composition.—The chemical composition of ergot has always been a subject of difficulty, and cannot be said to be yet settled. Ergot is now generally believed to contain three important bodies: 4 per cent. of *sclerotic acid*, 2½ per cent. of *scleromucin*, and *colouring matter*. Besides these, there occur in it 30 per cent. of a *fixed oil*, cholesterin, cellulose, mannite, lactic acid, abundance of potash salts, methylamin, trimethylamin, leucin, and several unimportant alkaloids. *Sclerotic acid*, $C_{12}H_{19}NO_9$, is a brownish hygroscopic substance without odour or taste, acid, forming salts readily soluble in water, and possessing the physiological action of the ergot itself. *Scleromucin* is a colloidal gummy-like mass, without odour or taste, soluble in water. It contains nitrogen, and has the same physiological action as sclerotic acid, but less marked. The *colouring matter* is also feebly active physiologically; it consists of several bodies, named *sclererythrin*, *scleroxanthin*, etc. The "ergotin" of manufacturers is an extract of the drug, not any of the active principles in a separate form.

Dose.—20 to 30 gr. *Of "Ergotin" hypodermically*, 1 to 3 gr.

Preparations.

1. Extractum Ergotæ Liquidum.—1 in 1, after washing with Ether. *Dose*, 15 to 30 min.
2. Infusum Ergotæ.—1 in 40. *Dose*, 1 to 2 fl.oz.
3. Tinctura Ergotæ.—1 in 4. *Dose*, 15 to 60 min.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

In large doses ergot is a gastro-intestinal irritant, but moderate doses may be given almost indefinitely without interfering with the stomach or bowels.

2. Action in the blood, and specific action.

The active principles of ergot enter the blood, but exert no appreciable change on it. Thence they pass into the tissues and organs, and set up well-marked symptoms, if given in full doses for a sufficient time. The parts chiefly affected are the central nervous system, respiration, circulation, intestines, and uterus. The highest centres (cerebral) are not directly influenced by ergot. **The spinal cord is distinctly affected,** a series of nervous phenomena being the result during life, and definite changes found in the posterior (Burdach's) columns after death. The patient first complains of creeping sensations in the limbs, as if an insect were running along the skin; sudden painful cramps or twitching of the legs follows; the gait becomes staggering (ataxic); and convulsions, with loss of sensibility and motion, may follow. These spinal effects are chiefly seen in cases of chronic "ergotism," where the drug has been consumed in large quantity in rye bread; but they indicate its mode of action, and may be met with clinically. The motor and sensory nerves and muscles are themselves unaffected. Respiration becomes infrequent after large doses, and death occurs by asphyxia. **The heart is reduced in frequency** by ergot, sometimes twenty to thirty-six beats per minute, and becomes feeble and irregular at last, possibly through the vagus, more probably through failure of the ganglia and want of venous charge. **The arteries become distinctly smaller** under ergot —according to some authorities, by vaso-motor stimulation; according to other authorities, by active venous dilatation, which drains the blood from the arteries, and causes them passively to contract. **The blood pressure falls steadily.** The intestine is peculiarly blanched under ergot, and consequently excited to peristaltic movements. **The uterus** becomes similarly anæmic, and **contracts actively,** especially if pregnant, and still more if parturition have commenced, when long and powerful pains are developed. These effects of ergot on the bowels and womb have been also referred to stimulation of their spinal centres. The body temperature falls. Gangrene frequently results from the protracted use of ergotised meal as an article of diet.

3. Specific uses.

Ergot is used chiefly to control hæmorrhage and to excite or increase uterine contraction. As a **hæmostatic,** acting apparently by lowering the blood pressure, it is extensively employed in hæmoptysis, hæmatemesis, menorrhagia, and intestinal hæmorrhage, where the hypodermic injection of

Diminishes the contractions of
the Heart in number.
Arteries are contracted
Blood pressure falls.
Ecbolic.
Haemostatic
Reduces Urine
" Sweat
" Milk

ergotin is rapid and effective, unless it alarm the patient and excite movement and palpitation, when it is better avoided. In aneurism it may be combined with rest and low diet to promote consolidation in the sac. The use of ergot in the second stage of labour should be confined to cases of uterine inertia where there is no obstacle in the passages; so frequently is this ecbolic abused, that it is calculated more harm than good has resulted from the discovery of its action in parturition. After the completion of the second stage, ergot may be more safely given to expel the placenta and clots, and ensure contraction of the womb; whilst in *post partum* hæmorrhage it is an invaluable adjuvant to more immediate remedies. In polypus uteri, chronic metritis, sub-involution, etc., ergot is also used with success. The action of ergot on the spinal cord suggests its rational application in paraplegia of inflammatory origin, sclerosis, etc., and instances of recovery under its influence are recorded. It has also been used in recurrent mania, referable to cerebral hyperæmia.

4. REMOTE LOCAL ACTION AND USES.

Ergot **reduces the amount of the urine, sweat, and milk,** more probably, however, through the blood pressure and the nervous centres of the glands in the brain and cord, than by direct action on the excreting cells. It is a valuable remedy in some cases of polyuria (diabetes insipidus), very rarely in saccharine (true) diabetes. The sweats of phthisis are said to be controlled by ergot. As an antigalactagogue it is but seldom employed.

Saccharum Purificatum—REFINED SUGAR.—$C_{12}H_{22}O_{11}$. Pure cane sugar prepared from the juice of the stem of Saccharum Officinarum. From plants cultivated in the West Indies and other tropical countries.

Characters.—Compact crystalline conical loaves, known in commerce as lump sugar. 100 parts are soluble in 45 of water or 10,000 of rectified spirit. It increases the solubility of lime in water. See *Liquor Calcis Saccharatus*, page 50.

Preparation.

Syrupus.—1 in 1½.

Sugar or Syrup is contained in all syrups and lozenges, several confections, and various mixtures, pills, powders, etc.

ACTION AND USES.

Sugar is **nutrient and demulcent**, but is chiefly used in medicine to cover the taste of other drugs.

Theriaca—Treacle (Sacchari Fæx).—The uncrystallised residue of the refining of sugar.

Characters.—A thick brown fermentable syrup, very sweet.

Theriaca is an ingredient of a number of pills.

ACTION AND USES.

Treacle is **demulcent, nutrient, and slightly laxative**, and is employed in pharmacy to make pills.

Coto Bark—Cortex Verus. **Paracoto Bark**—Cortex Para. (*Not Officinal.*)—The barks of two allied trees, from Bolivia.

Characters.—Coto bark resembles cinchona bark, with an aromatic resinous odour, and a pungent taste.

Composition.— Coto verus contains *cotoïn*, $C_{22}H_{18}O_6$, yellowish, amorphous or finely crystalline, with a balsamic odour and a bitter taste; nearly insoluble in water, soluble in spirit. Para bark contains *paracotoïn*, $C_{19}H_{12}O_6$, in minute pale crystals; insoluble in water.

Dose.—Of coto in powder, 1 to 8 gr.; of cotoïn, ½ to 2 gr.; of paracotoïn, 1½ to 3 gr.

Non-officinal Preparations.

Cotoïn; Paracotoïn; and a Tincture, given in doses of 10 min.

ACTION AND USES.

The only physiological effect of coto is as an **intestinal astringent**. It is useful in some cases of persistent subacute diarrhœa, as in phthisis and delicate subjects.

FILICES.

Filix Mas—Male Fern.—The dried rhizome, with the bases of the footstalks and portions of the

Anthelmintic

root fibres, of Aspidium Filix mas. Collected in summer.

Characters.—Tufted, scaly, greenish brown; powder greenish-yellow, with a disagreeable odour, and a nauseous, bitter, somewhat astringent taste.

Preparation.

Extractum Filicis Liquidum.—"Oil of Male Fern." Male Fern, 1; Ether, 2½. Percolate, and distil off the ether. *Dose*, 30 to 60 min.

Composition.—Male fern contains a colourless crystalline body, *filicic acid*, fixed and volatile oils, tannin, resins, and the ordinary constituents of plants. Which may be the active principle is uncertain.

ACTION AND USES.

Male fern is an active **anthelmintic**, peculiarly destructive to the tape-worm. It is less irritant to the stomach and bowels than cusso and kamala, and should be preceded and followed by a purgative. It is, on the whole, the most successful of anthelmintics when properly employed.

LICHENES.

Cetraria—Iceland Moss.—The entire lichen, Cetraria islandica. Native of the north of Europe.

Characters.—Foliaceous, lobed, crisp, cartilaginous, brownish-white, paler beneath; taste bitter, and mucilaginous. A strong decoction gelatinises on cooling.

Composition.—Cetraria contains 10 per cent. of *starch*; 20 per cent. of *lichenin*, $C_6H_{10}O_5$, a starch-like powder, not striking blue with iodine; and two bitter acids—*cetraric acid*, $C_{17}H_{16}O_8$, and *lichenstearic acid*, $C_{14}H_{24}O_3$.

Preparation.

Decoctum Cetrariæ.—1 to 20. *Dose*, 1 to 2 fl.oz.

ACTION AND USES.

Iceland moss is at once a **bitter tonic** and **nutritive** substance, but is not in general use as either.

Litmus.—A blue pigment prepared from various species of Roccella.

Characters.—Small blue lumps, readily reduced to powder.

Preparations.

1. **Tincture of Litmus.**—1 in 10.
2. **Blue Litmus Paper.**
3. **Red Litmus Paper.**

USE.

Litmus is employed only in chemical testing.

Cerevisiæ Fermentum—Beer Yeast.—The ferment obtained in brewing beer.

Characters.—Viscid, semi-fluid, frothy, exhibiting under the microscope numerous round or oval confervoid cells.

Dose.—One to two table-spoonfuls.

Preparation.

Cataplasma Fermenti.—Yeast Poultice. Yeast, 6; Flour, 14; Water (at 100°), 6. The mass to be placed near the fire till it rises.

ACTION AND USES.

Yeast poultice is believed to act as a **sedative and antiseptic**, and was formerly applied to sloughing sores, ulcers, and boils. Its value is very questionable.

Yeast has also been given internally on theoretical grounds in zymotic diseases and in diabetes, but probably without success.

FUNGI.

Muscariæ Nitras.—(*Not Officinal.*)—Nitrate of Muscarin, the liquid alkaloid of Agaricus muscarius or Amanita muscaria, the Fly Agaric.

Dose.—$\frac{1}{30}$ to $\frac{1}{3}$ gr.

ACTION AND USES.

The action of muscaria is almost exactly opposed to that of atropia in every respect, except that it dilates the pupil when applied locally. It also **contracts the pulmonary vessels.** It has been used as an **anhidrotic.**

GROUP II.

THE ANIMAL KINGDOM.

RODENTIA.

Castoreum — Castor. — The dried preputial follicles and their secretion, obtained from the Beaver, Castor Fiber, and separated from the somewhat shorter and smaller oil-sacs which are frequently attached to them. From the Hudson's Bay Territory.

Characters.—Follicles in pairs, about three inches long, fig-shaped, firm, and heavy, brown or greyish-black; containing a dry resinous reddish-brown or brown highly odorous secretion, in great part soluble in rectified spirit, and in ether.

Impurities.—Spurious sacs, filled with dried blood, etc.

Composition.—Castor contains, in addition to the ordinary constituents of animal secretions, such as salts, a *volatile oil*, *uric*, *carbolic* and *benzoic acids*, *salicin*, and *fixed oils*.

Dose.—5 to 10 gr.

Preparation.

Tinctura Castorei.—1 in 20. *Dose*, ½ to 1 fl.dr.

ACTION AND USES.

The action of castor is **stimulant** like that of musk. The drug is very seldom used.

RUMINANTIA.

Moschus—Musk.—The inspissated and dried secretion from the preputial follicles of Moschus moschiferus; native of the mountainous regions of Central Asia. Imported from China and India.

Characters.—In irregular, reddish-black, rather unctuous grains; having a strong, peculiar, very diffusible odour, and a bitter aromatic taste; contained in a round or slightly oval membranous sac, about two inches in diameter, covered on the outer side with stiff greyish hairs arranged in a concentric manner around its central orifice.

Composition.—Musk contains an *aromatic principle*, the

chemical nature of which is unknown, and a quantity of inactive substances, such as salts, fixed oils, etc.

Dose.—5 to 10 gr.

ACTION AND USES.

Musk is a powerful **stimulant** of the circulatory and nervous organs, acting probably much like turpentine and other volatile oils, *i.e.* chiefly reflexly from the nose, mouth, and stomach. It appears to enter the blood and tissues, and there rapidly causes depression, so that in full doses its stimulant effect is extremely evanescent. The drug is now but seldom used, chiefly as an antispasmodic in hysteria, laryngismus, and hiccup, and as a stimulant in fevers and pneumonia, when other measures have failed, and not then with much success.

Sevum Præparatum—Prepared Suet.—The internal fat of the abdomen of the sheep, Ovis Aries, purified by melting and straining.

Characters.—White, smooth, almost scentless; fusible at 103°.

Composition.—Suet is composed of *olein* and *stearin*. See *Adeps Præparatus*.

Preparation.

Sapo Animalis.—Curd Soap. Made with Soda and Prepared Fat. *Contained in* several suppositories, and Pilula Scammonii Composita.

Suet is also contained in Emplastrum Cantharidis and Unguentum Hydrargyri.

ACTION AND USES.

Suet is **emollient**, and used in the above preparations. Internally it is **nutritive**.

Saccharum Lactis—Sugar of Milk. $C_{12}H_{21}O_{12}$. A crystallised sugar, obtained from the whey of Milk by evaporation.

Characters.—Usually in cylindrical masses, two inches in diameter, with a cord or stick in the axis, or in fragments of cakes; greyish-white, crystalline on the surface and in its texture, translucent, hard; scentless, faintly sweet, gritty when chewed. Readily soluble in water.

Hepatic Stimulant.
Purgative.

Substance resembling Sugar of Milk: Acid Tartrate of Potash, known by taste, and without central cord.

ACTION AND USES.

Sugar of milk is less hygroscopic than ordinary sugar, and is thus more suitable as a vehicle for heavy powders. It is also used to sweeten preparations of milk for artificially fed infants.

Fel Bovinum Purificatum—Purified Ox Bile.—The purified gall of the Ox, Bos Taurus.

Source.—Prepared by agitating fresh ox bile with twice its volume of rectified spirit; separating the sediment of mucus; and evaporating the clear solution to the consistence of an extract.

Characters and tests.—A yellowish-green substance, having a taste partly sweet and partly bitter, soluble in water and in spirit.

Impurity.—Mucus, giving a precipitate with rectified spirit in watery solution.

Composition.—Purified ox bile has the composition of fresh bile, less the mucus removed by the rectified spirit.

Dose.—5 to 10 gr.

ACTION AND USES.

The action of bile in the duodenum is familiar, but when admitted into the stomach it is apt to cause vomiting, neutralising the gastric juice, precipitating the pepsin, and being itself rendered inactive. It was introduced as a bitter and cholagogue purgative, but is obviously of doubtful value. It may be used as a basis for aperient pills.

Pepsina—Pepsin.—A preparation of the mucous lining of the fresh and healthy stomach of the Pig, Sheep, or Calf.

Source.—Made by scraping the cleansed mucous membrane; drying the viscid pulp on a glass surface at 100°; and pulverising.

Characters.—A light yellowish-brown powder having a

faint, but not disagreeable odour, and a slightly saline taste, without any indication of putrescence. Very slightly soluble in water or spirit. Digests albumen.

Dose.—2 to 5 gr.

ACTION AND USES.

Pepsin is one of the normal constituents of the gastric juice, converting albumen into peptone with the assistance of the hydrochloric acid. The same effect is produced out of the body, or in other cavities such as the rectum.

Pepsin is extensively used as an **aid to digestion** either alone in the solid form, or combined with diluted hydrochloric acid, being given during or after meals. It is especially indicated and successful in morbid conditions of the stomach associated with deficiency of the gastric juice—whether from disease of the follicles, such as atrophy; excess of mucus, as in the chronic catarrhal dyspepsia of alcoholism, deficient blood supply, as in anæmia and general debility; or irritable states of the stomach with pain and vomiting, such as ulcer and cancer, where the normal stimulation of the mucous membrane must be avoided, and fluid food only given. Pepsin is also useful in the dyspepsia of the aged, and of infants. The principal objections to its use are the uncertainty of its strength and action, and the danger of allowing the gastric function to become obsolete.

Pepsin is a valuable addition to **nutritive enemata,** the natural digestive power of the secretion of the rectum being comparatively small.

Pepsin has also been used as a local application to dissolve the membrane in diphtheria, and even to promote the absorption of tumours.

Liquor Pancreaticus.—(*Not Officinal.*)—An aqueous and spirituous extract of the fresh pancreas of the Pig.

ACTION AND USES.

Preparations of the pancreas are active **digestives of proteids and amyloids,** and are used with great success to peptonise milk, gruel, and soups before administration in cases of digestive debility. They are not suited for separate internal use.

PACHYDERMATA.

Adeps Præparatus—Prepared Lard.—The purified fat of the Hog, Sus scrofa.

Characters and tests.—A soft white fatty substance, melting at about 100°. Has no rancid odour. Dissolves entirely in ether.

Impurities.—Common salt and starch.

Composition.—Lard consists of 60 per cent. of *olein*, and some *palmitin* and *stearin*. Olein is a fluid oil, a compound of oleic acid, $C_{18}H_{33}O_2$, and glyceryl, C_3H_5. Palmitin and stearin are solid oils, compounds of glyceryl with palmitic acid ($C_{16}H_{32}O_2$), and stearic acid ($C_{18}H_{36}O_2$) respectively.

Preparations.

1. **Adeps Benzoatus.**—1 of Benzoin in 64 of Lard.
2. **Unguentum Simplex.**—3 in 8, with White Wax and Almond Oil.

Either Lard or Benzoated Lard is contained in almost all ointments.

ACTION AND USES.

Lard is a simple **emollient**, forming the basis of most of the officinal ointments. Benzoated lard does not become rancid like ordinary lard, which for the same reason is now in a measure replaced by vaseline.

CETACEA.

Cetaceum—Spermaceti.—Nearly pure cetine, obtained, mixed with oil, from the head of the Sperm Whale, Physeter macrocephalus, inhabiting the Pacific and Indian Oceans. It is separated from the oil by filtration and pressure, and afterwards purified.

Characters.—Crystalline, pearly white, glistening, translucent, with little taste or odour, reducible to powder by the addition of a little rectified spirit. Scarcely unctuous to the touch; does not melt under 100°.

Substance resembling Spermaceti: White Wax, known by general appearance and hardness.

Composition.—Spermaceti is a fat, containing as its base, not glycerin but *cetylalcohol*, in combination with palmitic acid. $C_{16}H_{33}O.C_{16}H_{31}O$.

Preparations.

Unguentum Cetacei.—About 1 in 5, with White Wax and Almond Oil.

Cetaceum is used in preparing Charta Epispastica.

USE.

Spermaceti is an **emollient**, and is also employed pharmaceutically.

AVES.

Albumen Ovi—Egg Albumen.—The liquid white of the egg of Gallus Banckiva, *var.* domesticus.

Composition.—White of egg contains 86 per cent. of water, and 14 per cent. of solids, chiefly albumen, with a little fat, sugar, and sulphates.

ACTION AND USES.

White of egg is **demulcent and nutritive**, of value in some cases of irritability of the stomach. It is also a valuable **antidote** in poisoning by corrosives and irritants, especially perchloride of mercury, sulphate of copper, lead, and nitrate of silver.

Ovi Vitellus—Yolk of Egg.—The yolk of the egg of Gallus Banckiva, *var.* domesticus.

Composition.—Yolk of egg contains 16 per cent. of *albumin*, and a modification of it called *vitellin* (not precipitated by lead or copper); 30 per cent. of fatty bodies containing phosphorus and colouring matter, soluble in ether; *salts;* and *water*.

Preparation.

Mistura Spiritus Vini Gallici.—Egg Flip. The Yolks of 2 Eggs; Brandy, 4 fl.oz.; Cinnamon Water, 4 fl.oz.; Refined Sugar, ½ oz. *Dose*, 1 to 2 fl.oz.

ACTION AND USES.

Yolk of egg is highly **nutritive**, and the Mistura Spiritus Vini Gallici is a very valuable food and stimulant in conditions of extreme exhaustion.

PISCES.

Isinglass—The swimming bladder or sound of various species of Acipenser, prepared and cut into fine shreds.

Characters.—Light, coriaceous, whitish or yellowish, semi-transparent, inodorous, tasteless; insoluble in cold water, soluble in 24 parts of boiling water, forming a transparent jelly on cooling.

From Isinglass is made: Solution of Gelatine.

USE.

Isinglass is **nutrient**, Gelatine is **used in chemical testing.**

Oleum Morrhuæ—Cod-Liver Oil.—The oil extracted from the fresh liver of the cod, Gadus Morrhua, by the application of a heat not exceeding 180°.

Characters and test.—Pale yellow, with a slight fishy odour, and bland fishy taste. A drop of sulphuric acid added to a few drops of the oil on a porcelain slab develops a violet colour, which soon passes to a yellowish or brownish-red.

Composition.—Cod-liver oil consists chiefly of olein and margarin, but contains as much as 5 per cent. of free fatty acids (oleic, palmitic, stearic), traces of iodine and bromine, the ordinary inorganic salts of animal tissues and products, and trimethylamin $N(CH_3)_3$. Some authorities give bile as a constituent of cod-liver oil, others deny this entirely.

Impurities.—Inferior oils.

Dose.—1 to 8 fl.dr.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

The action and uses of oils externally have been fully discussed under the head of *Oleum Olivæ*, page 284.

Cod-liver oil is sometimes rubbed into the skin of wasting children as a nutrient, and with perfect success; but it imparts an objectionable colour and smell to the body.

With a little perseverance, it is as easily taken as other oils, and more easily digested, on account of the amount of

free acid which it contains, and which greatly facilitates saponification and emulsion, as well as absorption.

2. ACTION ON THE BLOOD.

Like olive and other oils, it enters the circulation, carrying with it traces of the other constituents. Increasing the richness of the chyle, it improves the quality of the blood, especially as regards the corpuscles, and is thus a **hæmatinic.**

3. SPECIFIC ACTION AND USES.

Passing into the cells, cod-liver oil is a nutrient of the first importance, whilst the traces of iodine, bromine, phosphates, other salts, and the trimethylamin doubtless produce a slight specific action when the oil is given continuously for months. The latter effects are, however, quite secondary to those of the oil proper, that is, to its effects as **a food.** Thus cod-liver oil differs from other oils (olive and almond oils, cream, butter, etc.), chiefly, but not solely, in respect of the ease with which it is digested and absorbed.

Cod-liver oil is very extensively used in almost all kinds of chronic disease attended by wasting. The chief of these diseases are scrofula in its various forms, phthisis, rickets, tertiary syphilis, chronic rheumatism, and general debility referable to misery, over-work, and under-feeding. In convalescence from acute illness it is of much service. It is also one of the best restoratives of the nervous functions, and of great value as a tonic in neuralgia, headache, mental irritability, despondency, and other less definite disorders, referable to exhaustion or inherent debility of the nervous centres.

In every instance where cod-liver oil is indicated, the first point to be determined is whether it can be taken and digested. Besides the difficulty of taste, two conditions distinctly contraindicate the exhibition of the oil, namely, diarrhœa and considerable fever. Gastric dyspepsia also suggests hesitation in the use of oil, but if alkaline stomachics are given before meals, and the oil after, it will be found to agree perfectly in most cases. If oil be persistently rejected, it should be stopped for a time, and again cautiously tried, or given with ether (10 minims of pure ether to 1 drachm of oil) or as an emulsion.

HYMENOPTERA.

Mel—HONEY.—A saccharine secretion deposited in the honeycomb, by Apis mellifica, the Hive Bee.

Characters and test.—When recently separated from the honeycomb, it is a viscid translucent liquid, of a brownish

yellow colour, which gradually becomes partially crystalline and opaque. Has a peculiar heavy odour, and very sweet taste.

Impurity.—Starch.

Composition.—Honey is a complex mixture of several kinds of *sugar* (cane and grape sugar, levulose or inverted sugar, derived by fermentation from the cane sugar); wax, pollen, colouring and odorous matters, etc.

Preparations.

Mel Depuratum.—Made by melting and straining.

From Mel Depuratum is prepared:

Oxymel.—8, with Acetic Acid, 1, and Water, 1.—*Dose*, 1 to 2 fl.dr.

Honey is also contained in Mel Boracis, Oxymel Scillæ, Confectio Piperis, Confectio Scammonii, and Confectio Terebinthinæ.

ACTION AND USES.

Honey increases the secretions of the mouth and throat, and thus acts as an **emollient**, relieving dryness, pain, cough and dysphagia. It is a popular ingredient of gargles, linctuses and cough mixtures, but to be useful must be properly employed as the oxymel, or in combination with lemon, which has a similar action on the mouth and pharynx. As a vehicle for borax it is used in aphthæ of the mouth, but is inferior to glycerine because fermentable. Honey is also **laxative** and **nutritive.**

Cera Alba—White Wax.—Yellow wax bleached by exposure to moisture, air, and light.

Characters.—Hard, nearly white, translucent. Not unctuous to the touch; does not melt under 150°.

Cera Flava—Yellow Wax.—The prepared honeycomb of the Hive Bee, Apis mellifica.

Characters.—Firm, breaking with a granular fracture, yellowish, having an agreeable honey-like odour. Not unctuous to the touch; does not melt under 140°; yields nothing to cold rectified spirit, but is entirely soluble in oil of turpentine.

Impurity.—Starch.

Composition.—Wax differs from ordinary fats in containing, as its base, not glycerine, but another alcohol, *melisyl-alcohol*, in union with *palmitic acid*, $C_{30}H_{61}O.C_{16}H_{31}O_2$.

Preparations.

Yellow and White Wax are used in preparing many Plasters, Ointments, Suppositories, and Charta Epispastica.

USE.

Wax is used only for the **pharmaceutical purposes** just mentioned. If given internally, it passes out in the fæces entirely unabsorbed.

HEMIPTERA.

Coccus—Cochineal.—The dried female insect, Coccus Cacti. Reared in Mexico and Teneriffe.

Characters.—Ovate, plano-convex, about two lines long, wrinkled, black or greyish-white; yields, when crushed, a puce-coloured powder. The greyish-white insect quickly becomes black when warmed before the fire.

Impurities.—Inferior Cochineal is "faced" with various white or black powders to improve its appearance. It *resembles* Kino, which has an astringent taste.

Composition.—Cochineal contains a red colouring principle, *carmin* or *carminic acid*, brownish-purple, amorphous; readily soluble in water and spirit.

Preparations.

Tinctura Cocci.—1 in 8.—*Dose*, ½ to 1½ fl.dr.

Coccus is also an ingredient of Tinctura Cardamomi Composita, (60 gr. to 1 pint); and Tinctura Cinchonæ Composita, (30 gr. to 1 pint).

ACTION AND USES.

Cochineal is used as a **colouring material** only.

COLEOPTERA.

Cantharis—Cantharides.—Cantharis vesicatoria. The Beetle, dried; collected chiefly in Hungary.

Characters.—From eight to ten lines long, furnished with two wing-covers of a shining metallic-green colour, under

Subastringent + Vesicant.
Diuretic
Aphrodisiac

which are two membranous transparent wings; odour strong and disagreeable. Powder greyish-brown, containing shining green particles.

Substance resembling powdered Cantharis: Kamala, which has no shining particles

Composition.—Cantharides contains ·20 to ·50 per cent. of *cantharidin*, a greenish *volatile oil*, and peculiar *fatty bodies*. Cantharidin, $C_{10}H_{12}O_4$, is obtained as shining colourless prisms, soluble in ether, chloroform, alcohol, and oils, and is the active principle, being a most powerful irritant. Some of the other properties of cantharides may possibly be referable to the oil.

Preparations.

1. **Acetum Cantharidis.**—1 in 10 of Glacial Acetic, and Acetic Acids.
2. **Charta Epispastica.**
3. **Emplastrum Cantharidis.**—1 in 3.
4. **Emplastrum Calefaciens.**—1 in 24.
5. **Liquor Epispasticus.**—Cantharides, 8; Acetic Acid, 4; Ether, to 20.
6. **Tinctura Cantharidis.**—1 in 80. *Dose*, 5 to 20 min.
7. **Unguentum Cantharidis.**—1 in 7.

ACTION AND USES.

1. IMMEDIATE LOCAL ACTION AND USES.

Externally.—Cantharis is a **rubefacient and vesicant** when applied to the skin, acting upon the nerves and vessels of the part like mustard and other measures of the same class, as described under *Sinapis*, to which the student is referred. Its effects differ from those of mustard chiefly in being much less rapid, but of a more severe degree. The Emplastrum or Charta has to be applied for a few hours before a sense of smarting, heat, and burning, is felt in the part; small vesicles then form, and at the end of eight to twelve hours have united into a single large bulla. The removal of the plaster after six hours, and the application of a poultice, will "raise the blister" more effectually and pleasantly. Vesication is decidedly more rapid after the application of the Acetum or Liquor Epispasticus. When the blister has been developed, the fluid is carefully incised, and the raw surface encouraged either to heal by simple dressing, or to discharge by the application of irritant ointments, such as Unguentum Sabinæ. Cantharis is the vesicant in ordinary use for purposes of counter-irritation.

Blisters are chiefly employed to control hyperæmia and the inflammatory process; to promote the absorption of morbid products; to relieve pain; and to arrest spasm and other reflex symptoms. The principle upon which they are believed to act is discussed under *Counter-irritants* in Part III.

Spanish fly is most frequently used in cerebral hyperæmia, being applied to the nape; in acute pleurisy, pericarditis, peritonitis, and meningitis—sometimes in the first stage, especially if pain be severe, but more frequently in the third stage, to promote absorption of effusions and exudations; in subacute or chronic inflammation of the viscera, such as pneumonia, when resolution is slow, or the disease threatens to become chronic; and in subacute or chronic inflammation of peripheral parts, such as the conjunctiva, joints, bones, etc. Neuralgia, if distinctly local in origin and due to congestion or inflammation of the nerves, is sometimes completely relieved by cantharides blisters; and the pains of acute rheumatism are undoubtedly dispelled by the same means, which is further believed by some physicians to cut short the whole rheumatic process. A blister on the epigastrium is a successful mode of treatment in some forms of gastric pain and vomiting.

In every instance, cantharis should be cautiously applied to children, to persons suffering from kidney disease, and to the aged and infirm. The back must not be blistered in bed-ridden persons, lest bed-sores be produced. Blisters must never be forgotten or left too long on the skin, otherwise ulceration may be set up, as well as the remote local effects of the drug to be presently described.

Internally.—Cantharis is an irritant to the mouth, throat, and stomach, and must be given well diluted and in small doses of the tincture only.

2. Action in the Blood, and Specific Action and Uses.

Cantharidin enters the blood both from the blistered surface and the stomach. The active principle finds its way into all the organs, to which it clings rather tenaciously. In large doses it disturbs the heart, respiration, and nervous system, producing a rapid pulse, headache, sensory disturbances, mental confusion, and finally death by asphyxia. It is not used in this connection.

3. Remote Local Action and Uses.

Cantharidin is slowly excreted by the kidneys, and appears in the urine, which conveys it to the bladder and genital organs. Here it sets up a second set of local effects similar to

its immediate action. Small doses cause a sense of heat in the perineum, itching of the meatus, frequent desire to micturate, and some diuresis. Larger doses set up acute parenchymatous nephritis, with all its characteristic symptoms, including scanty bloody urine, or even suppression; the penis becomes swollen, and painful erections occur, so that the drug has been described as an aphrodisiac. In women, the uterus may become congested and menstruation may be brought on.

In certain ill-understood cases of kidney disease, cantharis has proved a useful diuretic and renal alterative; also in some instances of disease or disorder of the bladder, prostate, and urethra, including spermatorrhœa. It is too dangerous a drug to be generally used for this purpose. For the same reason care must be taken to prevent the absorption of cantharidin by the skin.

ANNELIDA.

Hirudo—The Leech. — 1, Sanguisuga medicinalis, the Speckled Leech; and, 2, Sanguisuga officinalis, the Green Leech. Collected chiefly in France, Spain, Italy, and Hungary.

Characters.—Body elongated, two or three inches long, tapering to each end, plano-convex, wrinkled transversely; back olive-green, with six rusty-red longitudinal stripes. 1, belly greenish-yellow spotted with black; 2, belly olive-green not spotted.

ACTION AND USES.

The leech is employed to **abstract blood**, each leech removing, directly and by subsequent hæmorrhage, an average of half an ounce of blood. Leeching is depletive, and to some extent counter-irritant in effect; and is employed in a variety of congestive or inflammatory affections, superficial and visceral, as well as in cardiac distension and distress.

SYNOPSIS OF VEGETABLE AND ANIMAL PRODUCTS CONTAINED IN THE BRITISH PHARMACOPŒIA.

Leaves.

Digitalis
Stramonium
Aconitum
Conium
Cajuput
Uva Ursi
Buchu
Matica
Ruta
Senna
Laurocerasus
Belladonna
Hyoscyamus
Tabacum

Seeds of Fruit.

Nux Vomica
Hordeum
Linum Usitatissimum
Myristica
Ricinus Communis
Cardamomum
Stramonium
Sinapis
Gossypium
Areca
Amygdala
Physostigma
Colchicum
Triticum Vulgare
Croton Tiglium

Fruits.

Capsicum
Oliva
Coriandrum
Cubeba
Prunus
Anethum
Rosa Canina
Ficus
Ecbalium
Fœniculum
Limon
Aurantium
Anisum
Sabadilla
Hordeum Perlatum
Tamarindus
Bela
Cassia Pulpa
Conium
Uvæ
Colocynthis
Kamala
Rhamnus
Morus
Pimenta
Piper

Berries.

Piper
Pimenta
Kamala
Rhamnus

Roots.

Ipecacuanha
Calumba
Podophyllum
Rheum
Hemidesmus
Serpentaria
Gentiana
Jalapa
Valeriana
Armoracia
Krameria
Arnica
Pareira
Senega
Sumbul
Taraxacum
Sarsa
Granatum
Glycyrrhiza
Belladonna
Aconitum
Veratrum Viride
Zingiber
Filix Mas
Pyrethrum
Sassafras
Scammonia
Scilla
Colchicum

Barks.

Canella
Cascarilla
Cinnamomum
Mezereum
Cusparia
Nectandra
Cinchona
Ulmus
Larix
Quercus
Granati Radix

Concrete Oil.

Camphora
Theobroma
Myristica

Oil from the Oleo-Resin.

Cubeba
Terebinthina

Flowers or Buds.

Caryophyllum
Santonica
Papaver Rhœas
Crocus
Mentha Piperita
Mentha Viridis
Rosa Gallica
Rosa Centifolia
Sambucus Niger
Anthemis
Lavandula
Aurantium

Oil from Fruit or Seed.

Amygdala Amara
Amygdala Dulcis
Ricinus Communis
Anethum
Myristica
Anisum
Croton
Juniperus
Oliva
Linum
Carum
Caryophyllum
Coriandrum
Limon
Pimenta
Cubeba
Ruta

SYNOPSIS OF VEGETABLE AND ANIMAL PRODUCTS CONTAINED IN THE BRITISH PHARMACOPŒIA (*continued*).

Whole Plant.	Lignum.	Corms.	Tops.	Juices.
Chirata Dulcamara Lactuca Lobelia Rosmarinus	Quassia Hæmatoxylum Guaiacum Pterocarpus	Colchicum Scilla	Sabina Scoparium Cannabis Indica Dulcamara Cusso Lupulus	Opium Aloes Kino Lactucarium Guttapercha Morus Rhamnus Saccharum Theriacum Elaterium Catechu Pallidum
	Oleo-Resins.	Hair of Seed.		
Resins.		Gossypium	Gum Resins.	
	Terebinthina Canadensis Copaiba Elemi Thus Americanum		Cambogia Scammonium Ammoniacum Assafœtida Galbanum Myrrha	Gums.
Podophyllum Jalapa Scammonia Guaiacum Mastiche Pix Burgundica Pix Liquida Pinus (Resina)		Balsams.		Tragacantha Acacia
	Starch from Seed.	Peru Tolu Benzoinum Styrax Præparatus		Concrete Exudation.
	Amylum		Animal Products.	Manna
Oils from Leaves, Flowers, or Herbs.			Adeps Cantharis Castoreum Cera flava Cera alba Cetaceum Coccus Fel Bovinum Hirudo Lac Mel Ol. Morrhuæ Moschus Ovi Vitellus Saccharum Lactis Sevum Pepsin	Capsule.
	Lichen.	Alkaloids.		
Cajuput Lavandula Mentha Piperita Mentha Viridis Rosmarinus Ruta Cinnamomum Anthemis Sabina	Cetraria	Aconitia Atropia Beberia Morphia Quinia Strychnia Veratria		Papaver Somniferum
	Excrescence			Fungi.
	Galla			Ergota Cerevisiæ Fermentum

NON-OFFICINAL DRUGS.

The following Non-Officinal Drugs are extensively used in Medicine.

Name.	Part of Plant.	Name.	Part of Plant.
Actæa Racemosa.	Root.	Iris	Rhizome
Araroba	Powder.	Muscaria . . .	Alkaloid
Caffein	Alkaloid	Picrotoxine . .	Active Principle
Coca	Leaves.		
Convallaria . . .	Plant.	Quebracho . . .	Bark
Coto	Bark.	Rhamnus Frangula	Bark
Duboisia . . .	Plant.		
Eucalyptus . . .	Leaves.	Rhamnus Purshiana	Bark
Euonymus . . .	Bark.		
Gelsemium . . .	Root. [seeds.	Salix	Bark
Guarana . . .	Powdered	Spigelia	Root.
Hamamelis . . .	Bark.	Tormentilla . .	Root.

CLASSIFIED TABLES OF THE PHARMACEUTICAL PREPARATIONS OF THE BRITISH PHARMACOPŒIA.

Aquæ.—Anethi, Aurantii Floris, Camphoræ, Carui, Chloroformi, Cinnamomi, Destillata, Fœniculi, Laurocerasi, Menthæ Piperitæ et Viridis, Pimentæ, Rosæ, Sambuci.

Aceta.—Cantharidis, Scillæ.

Cataplasmata.—Carbonis, Conii, Fermenti, Lini, Sinapis, Sodæ Chloratæ.

Chartæ.—Epispastica, Sinapis.

Confectiones. — Opii, Piperis, Rosæ Caninæ et Gallicæ, Scammonii, Sennæ, Sulphuris, Terebinthinæ.

Decocta.—Aloes Compositum, Cetrariæ, Cinchonæ Flavæ, Granati Radicis, Hæmatoxyli, Hordei, Papaveris, Pareiræ, Quercus, Sarsæ, Sarsæ Compositum, Scoparii, Taraxaci, Ulmi.

Emplastra.—Ammoniaci cum Hydrargyro, Belladonnæ, Calefaciens, Cantharidis, Cerati Saponis, Ferri, Galbani, Hydrargyri, Opii, Picis, Plumbi, Plumbi Iodidi, Resinæ, Saponis.

Enemata.—Aloes, Assafœtidæ, Magnesiæ Sulphatis, Opii, Tabaci, Terebinthinæ.

Essentia.—Anisi, Menthæ Piperitæ.

Extracta:

1. **Acetic Extract.**—Colchici Aceticum.
2. **Alcoholic Extracts.**—Cannabis Indicæ, Physostigmatis, Nucis Vomicæ, Jalapæ, Rhei, Lupuli, Papaveris, Colocynthidis Compositum, Stramonii.

3. **Aqueous Extracts.**—Calumbæ, Gentianæ, Aloes Barbadensis et Socotrinæ, Pareiræ, Hæmatoxyli, Anthemidis, Glycyrrhizæ, Krameriæ, Quassiæ, Opii.

4. **Ethereal Extracts.**—Ergotæ Liquidum, Filicis Liquidum, Mezerei Æthereum, Stramonii.

5. **Fresh Extracts.**—Colchici, Colchici Aceticum, Taraxaci.

6. **Green Extracts.**—Aconiti, Belladonnæ, Conii, Hyoscyami, Lactucæ.

7. **Liquid Extracts.**—Ergotæ Liquidum, Belæ Liquidum, Pareiræ Liquidum, Sarsæ Liquidum, Cinchonæ Flavæ Liquidum, Opii Liquidum, Filicis Liquidum.

Glycerina. — Acidi Carbolici, Acidi Gallici, Acidi Tannici, Amyli, Boracis.

Infusa.—Anthemidis, Aurantii, Aurantii Compositum, Buchu, Calumbæ, Caryophylli, Cascarillæ, Catechu, Chiratæ, Cinchonæ Flavæ, Cuspariæ, Cusso, Digitalis, Dulcamaræ, Ergotæ, Gentianæ Compositum, Krameriæ, Lini, Lupuli, Maticæ, Quassiæ, Rhei, Rosæ Acidum, Senegæ, Sennæ, Serpentariæ Uvæ Ursi, Valerianæ.

Injectio.—Morphiæ Hypodermica.

Linimenta.—Aconiti, Ammoniæ, Belladonnæ, Calcis, Camphoræ, Camphoræ Compositum, Chloroformi, Crotonis, Hydrargyri, Iodi, Opii, Potassii Iodidi cum Sapone, Saponis, Sinapis Compositum, Terebinthinæ, Terebinthinæ Aceticum.

Liquores.—Ammoniæ, Ammoniæ Acetatis, Ammoniæ Citratis, Ammoniæ Fortior, Antimonii Chloridi, Arsenicalis, Arsenici Hydrochloricus, Atropiæ, Atropiæ Sulphatis, Bismuthi et Ammoniæ Citratis, Calcis, Calcis Chloratæ, Calcis Saccharatus, Chlori, Epispasticus, Ferri Perchloridi, Ferri Perchloridi Fortior, Ferri Pernitratis, Ferri Persulphatis, Guttæ Perchæ, Hydrargyri Nitratis Acidus, Hydrargyri Perchloridi, Iodi, Lithiæ Effervescens, Magnesiæ Carbonatis, Magnesiæ Citratis, Morphiæ Acetatis, Morphiæ Hydrochloratis, Plumbi Subacetatis, Plumbi Subacetatis Dilutus, Potassæ, Potassæ Effervescens, Potassæ Permanganatis, Sodæ, Sodæ Arseniatis, Sodæ Chloratæ, Sodæ Effervescens, Strychniæ, Zinci Chloridi.

Lotiones.—Hydrargyri Flava, Hydrargyri Nigra.

Mella.—Boracis, Depuratum, Oxymel.

Misturæ. — Ammoniaci, Amygdalæ, Creasoti, Cretæ, Ferri Aromatica, Ferri Composita, Gentianæ, Guaiaci, Scammonii, Sennæ Composita, Spiritus Vini Gallici.

Mucilagines.—Acaciæ, Amyli, Tragacanthæ.

Olea.—Amygdalæ, Anethi, Anisi, Anthemidis, Cajuputi, Carui, Caryophylli, Cinnamomi, Copaibæ, Coriandri, Crotonis,

Cubebæ, Juniperi, Lavandulæ, Limonis, Lini, Menthæ Piperitæ et Viridis, Morrhuæ, Myristicæ, Myristicæ Expressum, Olivæ, Phosphoratum, Pimentæ, Ricini, Rosmarini, Rutæ, Sabinæ, Sinapis, Terebinthinæ, Theobromæ.

Pilulæ.—Aloes Barbadensis, Aloes et Assafœtidæ, Aloes et Ferri, Aloes et Myrrhæ, Aloes Socotrinæ, Assafœtidæ Composita, Cambogiæ Composita, Colocynthidis Composita, Conii Composita, Ferri Carbonatis, Ferri Iodidi, Hydrargyri, Hydrargyri Subchloridi Composita, Ipecacuanhæ cum Scillâ, Phosphori, Plumbi cum Opio, Quiniæ, Rhei Composita, Saponis Composita, Scammonii Composita, Scillæ Composita.

Pulveres.—Amygdalæ Compositus, Antimonialis, Catechu Compositus, Cinnamomi Compositus, Cretæ Aromaticus cum Opio, Glycyrrhizæ Compositus, Ipecacuanhæ Compositus, Jalapæ Compositus, Kino Compositus, Opii Compositus, Rhei Compositus, Scammonii Compositus, Tragacanthæ Compositus.

Spiritûs.—Ætheris, Ætheris Nitrosi, Ammoniæ Aromaticus, Ammoniæ Fœtidus, Armoraciæ Compositus, Cajuputi, Camphoræ, Chloroformi, Juniperi, Lavandulæ, Menthæ Piperitæ, Myristicæ, Rectificatus, Rosmarini, Tenuior, Vini Gallici.

Succi.—Belladonnæ, Conii, Hyoscyami, Scoparii, Taraxaci.

Suppositoria.—Acidi Carbolici cum Sapone, Acidi Tannici, Acidi Tannici cum Sapone, Hydrargyri, Morphiæ, Morphiæ cum Sapone, Plumbi Compositum.

Syrupi.—Simplex, Aurantii, Aurantii Floris, Chloral, Ferri Iodidi, Ferri Phosphatis, Hemidesmi, Limonis, Mori, Papaveris, Rhœados, Rhamni, Rhei, Rosæ Gallicæ, Scillæ, Tolutanus, Zingiberis.

Tincturæ.—*Those made with Rectified Spirit* are: Aconiti, Arnicæ, Assafœtidæ, Benzoini Composita, Cannabis Indicæ, Capsici, Castorei, Chloroformi Composita, Cubebæ, Ferri Acetatis et Perchloridi, Iodi, Kino, Lavandulæ Composita, Myrrhæ, Nucis Vomicæ, Opii Ammoniata, Pyrethri, Tolutana, Veratri Viridis, Zingiberis Fortior.

Those made with Proof Spirit are: Aloes, Aurantii, Belladonnæ, Buchu, Calumbæ, Camphoræ Composita, Cantharidis, Cardamomi Composita, Cascarillæ, Catechu, Chiratæ, Cinchonæ Composita et Flavæ, Cinnamomi, Cocci, Colchici Seminum, Conii Fructûs, Croci, Digitalis, Ergotæ, Gallæ, Gentianæ Composita Hyoscyami, Jalapæ, Krameriæ, Limonis, Lobeliæ, Lupuli, Opii, Quassiæ, Quiniæ Ammoniata, Rhei, Sabinæ, Scillæ, Senegæ, Sennæ, Serpentariæ, Stramonii, Sumbul, Valerianæ.

Those made with Aromatic Spirit of Ammonia, or Ammonia, are: Guaiaci Ammoniata, Valerianæ Ammoniata, Opii Ammoniata.

One in which Ether is used: Lobeliæ Æthereæ.

One in which Tincture of Orange is used: Quiniæ.

Trochisci.—Acidi Tannici, Bismuthi, Catechu, Ferri Redacti, Ipecacuanhæ, Morphiæ, Morphiæ et Ipecacuanhæ, Opii, Potassæ Chloratis, Sodæ Bicarbonatis.

Unguenta.—Aconitiæ, Antimonii Tartarati, Atropiæ, Belladonnæ, Cadmii Iodidi, Cantharidis, Cetacei, Creasoti, Elemi, Gallæ, Gallæ cum Opio, Hydrargyri, Hydrargyri Ammoniati, Hydrargyri Compositum, Hydrargyri Iodidi Rubri, Hydrargyri Nitratis, Hydrargyri Oxidi Rubri, Hydrargyri Subchloridi, Iodi, Picis Liquidæ, Plumbi Acetatis, Plumbi Carbonatis, Plumbi Iodidi, Plumbi Subacetatis Compositum, Potassæ Sulphuratæ, Potassii Iodidi, Resinæ, Sabinæ, Simplex, Sulphuris, Sulphuris Iodidi, Terebinthinæ, Veratriæ, Zinci.

Vapores.—Acidi Hydrocyanici, Chlori, Coniæ, Creasoti, Iodi.

Vina.—Aloes, Antimoniale, Aurantii, Colchici, Ferri, Ferri Citratis, Ipecacuanhæ, Opii, Quiniæ, Rhei, Xericum.

Part III.

GENERAL THERAPEUTICS.

CHAPTER I.

INTRODUCTION: THE FOUNDATIONS OF RATIONAL TREATMENT.

The terms Therapeutics and Treatment, although they may at first sight appear too simple to call for analysis, are found, on careful consideration, to include four different notions. These we must study individually.

1. **Health.**—The first notion involved in Treatment is a purely *physiological* one, the conception of *health*, or the normal state, from which the organ has departed, and to which it has to be restored. Health is the result of a number of natural influences acting on the individual, namely, the *extrinsic* circumstances around him, and the *intrinsic* conditions which he brought into the world with him. Our organs having reached their present state by a process of evolution under the influence of the various natural forces which surround us, are obedient to these influences; and when a definite change is thus produced upon them, we call it the "physiological action" of the influence. The first point for the therapeutist to appreciate is, that just as the forces which surround us are themselves constantly varying—the various conditions of the temperature, the air, our food, in short our whole environment, being inconstant—so the physiological state of the body is not a constant quantity. We speak of a "normal" state, and call it "health," but the first essential of life and health is power of change and accommodation to varying circumstances.

2. **Pharmacodynamics: Physiological action.**—The second elementary notion in the expression "treatment" is, that we possess a certain power of interference, a control over the conditions and circumstances of life, and thus a certain control over the health or physiological state of the individual. A very little consideration will enable us to appreciate our power over the forces of nature. Most of the influences we have just considered as normal in their effects, and many that are entirely morbid in character, are within our control. We can alter the food we eat, the air we breathe,

our clothing, our sources of heat; we may admit into our bodies substances which we find in nature—mineral, vegetable, animal, or altogether artificial. On the other hand, we may voluntarily shun or reject such substances, and avoid many influences, whether for good or for bad, around us. To express this control which we have over our organs and functions, through the conditions to which we can voluntarily subject them, we say we *act physiologically upon them* by such and such means, or that such and such a substance has such and such a *physiological action;* and the science that relates to this power which we possess of modifying physiological activity we call *Pharmacodynamics.*

3. **Pathology.**—The conception of *disease* is also included in "treatment." When the conditions which surround us become unusual or extraordinary, they lead to disturbance of the vital processes. If this be moderate, it is still included under the name of "health;" but if considerable, it is called *disorder* or *disease*, and the influence is called a *morbid* influence. It is essentially impossible to draw a line between health and disease, just as it is impossible to divide influences into salutary or physiological, and morbid or pathological. The pulse is accelerated by joy, by wine, by fever; which of these conditions is health, which disease? All that can be said is, that the change from the normal state is frequently so definite that we cannot reasonably call it "health," that we must find another name for it, and call it "disorder;" or if it be more marked, and attended by suffering, "disease."

4. **Recovery.**—Successful treatment necessarily involves a *power of recovery*. The body possesses abundant provisions for preventing disease, and of recovering from its effects. This power of meeting and overcoming morbid influences depends essentially on the great physiological law which we have already noticed, that the activity of the tissues and organs is not fixed and constant, but varies (within certain limits) with the conditions to which it is subjected. The body is abundantly provided with the following means by which this variation of functional activity can be secured:

First, when occasion demands it, the organs can display an *extraordinary amount of force*, as we see in the case of a muscle such as the biceps, or the heart. The organs thus possess a certain amount of *reserve force*, which is frequently called into play as a means of preventing disease. But for this, we should break down in every part of our body as often as we made an extra demand upon it.

Secondly, if this reserve force be constantly called into play by the continuance of some extraordinary cause, the

increased activity gives rise to enlargement or hypertrophy of the organ, and what is known as *compensation* is the result. This great natural method of prevention or recovery by *overcoming the cause of disorder* is well seen in heart disease, and in enlargement of one kidney when the other is diseased.

Instead of themselves meeting extraordinary circumstances by extraordinary activity, many organs are provided with *regulating mechanisms*, by which they can throw them off or escape from them, that is, *expel the cause of disorder*. The stomach rejects a heavy or improper meal; the heart can, to some extent, relieve itself of excessive peripheral resistance in systole, through the depressor mechanism; and the body heat is elaborately regulated by various nervous arrangements.

Thirdly, the work of one organ may sometimes be undertaken by another organ, which thus *removes the effects* of the disorder. This is called *vicarious compensation*, and is well seen at work between the kidney and other excretory organs.

Fourthly, even when disease and anatomical change have actually occurred, the body possesses means of recovery of the nature of *repair*, which is associated with nutritive activity and frequently with the inflammatory process.

These considerations teach us that just as our organs and functions continue normal, like everything else in nature, in obedience to the laws under which they have reached their present form, so, if they have become deranged by unusual influences, they will return to the normal when such abnormal influences have been overcome or removed.

5. **Therapeutics.**—The following are the four foundations of rational therapeutics. (1) Inasmuch as the organs act in obedience to natural forces in and around us; (2) since we possess the power of controlling these forces; (3) since disorder and disease are but the physiological phenomena, or the anatomical results of the disturbing action of ordinary or extraordinary influences; and (4) since the functions of the organs, and, it may be, even their anatomical state will return to the normal, if the influences become normal: it logically follows that therapeutics as a science consists in bending to our will the numerous natural forces which affect the human body, or in counteracting or neutralising their effects by other forces, until, in either case nature returns to the normal. To handle, as it were, the natural influences which surround us in such a manner as to effect this change on the functions of the body, is called *treating the disorders or diseases* of it. It is with this meaning that we shall speak of *rational treatment*.

Now it is evident that treatment may be of many kinds:

1. **Preventive treatment.**—The science and art of preserving health is known as *Hygiene*, and it is manifestly founded on an accurate knowledge of physiology. If we thoroughly understood physiology, and had unlimited power over the forces of nature, we might so preserve health that disease would be unknown. Unfortunately, we have neither this knowledge nor this power except in a small measure, and hygiene is correspondingly imperfect; but as far as it goes, hygiene renders therapeutics unnecessary.

Another form of preventive treatment is *prophylaxis*. This is something more than simple hygiene or preservation of health; it recognises the causes of disease at work, and either avoids them or counteracts them by anticipation.

Prophylactic treatment may be either *negative* or *positive:* a man may guard against infection by avoiding certain things, such as water which is poisoned by cholera or typhoid fever; or he may have himself vaccinated to prevent small-pox, take quinia to prevent ague, or drink lemon-juice to prevent scurvy.

2. **Immediate treatment.**—When hygiene and prophylaxis are powerless or cannot be employed, the case comes into the hands of the therapeutist. The organism is disturbed, deranged, or diseased, and now there is an occasion for *therapeutics*, for *remedy*, for *relief*, or for *cure*. All these terms manifestly imply a necessity for interference, that is, the actual presence of derangement from the normal state, and they introduce us to our own proper subject.

a. Removal of the cause.—Having met with a case of disease which we have failed to prevent, we first naturally try to *remove or destroy the cause*, and thus restore the normal state We extract a foreign body from the finger, or a poison or indigestible meal from the stomach; we neutralise an acid by an alkali; we kill parasites. In doing so, we simply follow nature's second method of recovery. Now there are manifestly as many ways of effecting a cure as there are causes of disease. We may alter the food, and then we say the treatment is **dietetic**; we may alter the atmosphere, and then we say the treatment is **climatic**; or we may employ the chemical and other substances contained in the Pharmacopœia, when our treatment will become **medicinal.**

b. Symptomatic treatment.—If we fail to remove the morbid influence, we may attempt to *neutralise or counteract its morbid effects* on the body. Knowing the physiological action of many different measures, we select such as act in an opposite direction to the morbid cause, and employ them to counteract it. As a method of treatment this is manifestly much inferior to the preceding; we are now striking not at the cause of disease,

but only at its effects. Still even this limited power may be of the greatest value; sometimes it is all that is required—we may have to treat only the effect that persists after the cause has ceased or been removed, especially in sensitive and vital organs. This kind of treatment is called **symptomatic, palliative,** and under certain circumstances **expectant** (*expectare*, to wait); it is manifestly a copy of the third method of natural recovery.

It is evident that we have before us here an enormous field for research and application. If we can but find a means, whether medicinal or not, which shall counteract each abnormal condition to which the body may be subjected, we may defy disease. But here we are met by certain difficulties. Before we can hope to combat disease in this way, we must know (1) all about disease and its causes, that is, we must have a perfect pathology; and (2) all about the effects of therapeutical agents upon the body, that is, have a complete pharmacodynamics or pharmacology. It is unnecessary to say how far either the one or the other of these is from being a complete science. Another discouraging fact is that there is a *limit* to all hope of a cure, a limit to all treatment, because the morbid influence may have so far anticipated the remedial as to have altered the body structurally. If a limb is lost, we cannot restore it; if the mitral valve is covered with diseased growth, we cannot renovate it. But we are right when we maintain that these organic structural changes, grave or hopeless as they may be, are but the results of the action of some cause with simple beginnings, which we shall yet discover. As our knowledge of pathology advances we are steadily learning, *e.g.* more about the nature and origin of cancer, for which the limb had to be removed; more about the causes of rheumatism, which covered the cardiac valve with unnatural growth. If we ever cure cancer and rheumatism, we shall manifestly do so by influencing the causes or the beginnings of the two diseases: medicines may be expected to affect morbid *processes* rather than *products*, to alter morbid physiology rather than morbid anatomy. We do, however, possess certain means of treating even structural changes of organs, as we shall discover when we come to discuss metabolism.

The student is now in a position to consider the meaning of two terms constantly being employed in therapeutics—namely, **rational treatment** and **empirical treatment.** Treatment is said to be *rational* when it is suggested by all our chemical, physiological, and pathological knowledge. Such treatment must be successful if our observations are correct: it is founded on great natural laws which are known and understood. *Empirical* treatment is founded on experience only, and conforms to

no yet known law. It may be, and frequently is, as successful as rational treatment, or sometimes even more so; but whether successful or unsuccessful, we can offer no scientific reason for it. All that we can say is, that experience has proved incontestably that a particular kind of treatment was beneficial in a multitude of instances, and that it will probably be beneficial again. We hope soon to know more about the various remedies that have been successfully employed; and as we acquire this knowledge, and come to be able to give a reason for their effects, *i.e.* refer them to some great natural law, we shall transfer these remedies from the group headed "empirical," and add them to the group called "rational." Therapeutics will become a perfect science when empiricism has thus without exception given place to rationalism.

Plan of the following chapters.—In approaching the study of the general therapeutics of the different systems of the body, we will adopt the following plan suggested by the preceding considerations: (1) We shall give a brief sketch of the *physiological* relations of the system. (2) We shall consider fully the *pharmacodynamics* of the same, dealing chiefly with the drugs examined in the previous parts of the work, but referring frequently to non-medicinal measures, such as food, air, exercise, and baths. (3) A rapid sketch will be given of some of the *pathological* relations of the system, those being selected which best serve to illustrate the action and uses of remedies, *i.e.* disorders or derangements rather than diseases of the parts. (4) A brief reference will be made to the evidence of *natural recovery* in the particular system, and to the failure of such attempts, *i.e.* the *limits of treatment*. (5) The *rational therapeutics* of the system, founded on the previous four divisions, will complete the account.

CHAPTER II.

DIGESTION.—THE MOUTH.

I. Physiological Relations.

The process of digestion begins with the reception of food, more or less prepared by cooking. During its brief stay in the mouth, the food is triturated and mixed with mucus and saliva, and its starchy constituents are partly converted into sugar.

1. *Food* forms no part of the subject of the present work, and it will be sufficient to remind the student that the chief proximate principles of a proper diet are proteids, amyloids, fat,

salts, and water. The relative proportions of these constituents vary greatly in different kinds of food.

2. The *sensory nerves* of the mouth (the glosso-pharyngeal, and the lingual and other branches of the trigeminus) receive and transmit to the cerebrum and medulla the impressions of taste, as they are commonly called, whether sweet (the pleasant taste referable to amylolytic action), bitter, salt, sour, hot, burning, warm, pungent, acrid, or nauseous; and the many kinds of aromatic flavours, which are chiefly, however, odours. In the medulla the gustatory impressions fall into a special centre, whence they are reflected (1) to the stomach, the functions of which they modify, as we shall see; and (2) to the salivary and mucous glands of the mouth, which they also influence, chiefly through the chorda tympani. Through the same efferent nerve come other impulses: from the cerebrum, as the result of the sight, taste, smell, or even idea of food; from the stomach, conveyed by the vagus; and, doubtless, from many other sensitive parts, especially in the abdomen.

3. The *flow of saliva and mucus* is the result of the nervous impulses which have just been traced, and which stimulate the protoplasm of the epithelial cells, and actively dilate the vessels. The saliva is secreted at the commencement of digestion, is intimately mixed with the food, and imparts to the bolus a faintly alkaline reaction which has an important effect on secretion in the stomach.

4. It is well to distinguish from the ordinary secretions of the mouth, the *excretions* which are also thrown out by the glands. Although these are but little appreciated in health, they are familiar as the source of certain unpleasant tastes in the mouth and odours of the breath, after particular kinds of food and drink, such as wines, and many drugs.

5. The *muscular acts* of mastication and swallowing are guided by the afferent impressions and by the will.

II. Pharmacodynamics.

We come now to inquire, according to the plan which we have sketched, whether we possess any means of influencing the normal functions of the mouth, and if so, how far such powers can be usefully applied.

1. *Food.*—We have absolute control over our food. We can withhold it altogether; we can alter its quantity and its quality as we please. Especially as regards the mouth, we may modify the proportion of amyloids in the diet, affect their condition by cookery, or convert them wholly or partially into sugar before administration. Malt extracts consist chiefly of dextrin and maltose, made from malted grain and flour.

The control which we thus possess over food is the foundation of the vast subject of dietetics.

2. The *sensory apparatus* in the mouth can be variously influenced. The variety of natural tastes and flavours of which we may avail ourselves is endless; artificial products are hardly less numerous. The art of cookery is much concerned with the proper use of these; so is the growth of wines; and the many natural and artificial condiments act chiefly upon the palate, such as mustard, pickles, and sauces. Beyond the culinary art, an immense number of medicinal agents are contained in the materia medica which may be used in therapeutics proper, to act upon the tongue and palate, and thus upon the nervous centres and viscera. These may be arranged as follows: (1) The great group of warm **aromatic** oils, including Cloves, Allspice, Peppermint, Rosemary, Lavender, Nutmeg, and many others, each with its own peculiar flavour; (2) **bitters**, such as Calumba, Quassia, Quinia, etc.; (3) **aromatic bitters**, of which Gentian, Orange, and Cascarilla are examples; (4) the **spirituous** group, including Spirits, Wines, Chloroform, and Ether; (5) **pungent** substances proper, such as Mustard, Horseradish, and Pyrethrum; (6) **sweet** substances, including Sugar, Liquorice, Glycerine, etc.; and (7) **acid or sour** substances, such as the Mineral Acids, Acid Fruits, and Acid Tartrate of Potash, to which we shall presently return.

The value of aromatics, bitters, and the other stimulants of the nerves of the mouth, lies in the fact that whilst they increase relish or the enjoyment of eating, and thus the appetite and the amount of food consumed, they provide for the digestion of this increased quantity of nourishment by stimulating the secretion of the digestive fluids in the mouth, and, as we shall see in the next section, in the stomach also.

The effect of these substances on the palate also affords us means of covering the tastes of nauseous medicines, of which we constantly avail ourselves. On the other hand, we may employ the unpleasant taste or flavour of certain drugs, such as Valerian and Assafœtida, to produce through the afferent nerves a powerful influence on the sensorium which we may sometimes have occasion to employ.

3. *Salivary and mucous glands.*—Substances and measures which increase the flow of saliva are called **sialagogues** (σίαλον, saliva, and ἄγειν, to cause to flow), and include the greater number of the stimulants of the sensory apparatus just classified. Of these the most important sialagogues are unquestionably diluted acids, including the Diluted Mineral Acids,

Carbonic Acid in effervescence, Vegetable Acids and their salts, wines (which are all acid to a degree), and acid fruits and juices, of which Lemon may serve as a type. The familiar effect of acid drinks in relieving thirst cannot, however, be entirely explained by their influence on the nerves of taste. Here the student is introduced to a great physiological law, which we shall frequently have occasion to notice, *that acid substances stimulate alkaline secretions, and alkaline substances stimulate acid secretions.* The action is probably a local one, the acid or alkali, as the case may be, being quickly absorbed, and reaching the protoplasm of the glands direct.

Other drugs act as *specific sialagogues* upon the terminations of the portio dura in the salivary glands, or on the cells themselves. Such are Jaborandi, and its active principle Pilocarpin, Tobacco, Physostigma, Mercury and Iodine, and the indirect emetics Antimony and Ipecacuanha.

Opposed to these measures are the **antisialagogues,** equally at our service, although but rarely employed. Such are *insipid or nauseous* articles of food or medicine, with which may be classed *depressing emotions and other nervous influences;* dilute *alkaline* or soapy substances acting locally, such as Potash, Soda, and Lime; and certain articles of the first importance in the materia medica which act upon the secreting nerves, and may, therefore, be called *specific antisialagogues.* The type of these is Belladonna (Atropia), with Hyoscyamus, and Stramonium (Hyoscyamia). Tobacco in excess has the same effect, as well as Opium.

If the natural secretion fail, certain *substitutes* for the mucus may be employed, which are called **demulcents** (*demulcere*, to soothe), as they sheathe the mouth, tongue, and fauces with a protective coating. Such are simple drinks, especially tepid water, toast-water, water and milk; mucilaginous preparations, in a fluid or solid form, including barley-water, gruel, and linseed tea; various preparations of gelatine and isinglass; lozenges made with gums; preparations of starch, eggs, honey, figs, and bread; palatable oils; syrups; and ice.

4. The *excretions* of the mouth can also be influenced by means of substances which are thrown out of the system by this channel, such as Iodine, Lead, and Mercury. The therapeutist can hardly be said to avail himself of this means of acting on the mouth.

5. The *mastication and insalivation* of the food can also be regulated, on the one hand by insuring time and care in the process of eating, and on the other hand by ordering such a diet as is entirely fluid, or may be thoroughly triturated and exposed to the juices of the mouth.

III. Pathological Relations.

As has been already suggested, the pathological relations of the mouth and the first part of the digestive process, are of less interest in themselves, for our present purpose, than from their bearing upon digestion in the stomach, and the farther progress of the food.

1. We discover in the *food* the chief cause of all digestive disorders, whether it be unsuitable in quality, excessive in quantity, or taken at over frequent or irregular times.

2. Loss of the *sense of taste* is familiar in fever, the result being further arrest of the salivary flow, and interference with relish and appetite, always a serious matter in such cases. In this connection must be mentioned the unfortunate tastes of most drugs, the difficulty of their administration, and the degree to which they interfere with the appetite.

3. Disorders of the *secretions* of the mouth include chiefly disturbances of the quantity of saliva and mucus. The saliva is probably deficient in some cases of long standing indigestion; and it is markedly wanting in acute febrile conditions, causing dryness of the tongue and mouth, thirst, loss of relish as we have just seen, and inability to swallow, the morsel being rolled hopelessly about the mouth. A somewhat similar condition may be induced by depressing emotions, such as fear or grief; or by certain medicinal or dietetic substances, including Belladonna, Opium, and Alcohol. Excessive secretion of saliva and mucus ("salivation") was very frequent in the days when Mercury was regularly administered until the "gums were touched"; and is still occasionally seen from the same cause, as the result chiefly of accident or idiosyncrasy; or as the effect of Iodine and Iodide of Potassium, under similar circumstances. A *reflex* salivary flow of a very interesting kind occurs at the commencement of vomiting, and in some cases of gastro-intestinal disorder, constituting one form of "pyrosis" or "water-brash." In other cases salivation is produced by disease of the nervous centres.

4. Derangements of the *excretions* of the mouth are among the causes of the "bad taste" and unpleasant odour of the breath, connected with digestive derangements; the other principal causes of the same being decomposition in the mouth, or excretion by the respiratory passages. Some drugs already mentioned have the same effect, such as Mercury, Iodine, Bromine, and Lead; and the prevention of this unpleasant action may be a difficult task.

5. Second only to the food itself as a frequent cause of indigestion is the imperfect manner in which the *mechanical*

processes in the mouth are performed, the solids being imperfectly masticated and insufficiently insalivated from hasty or careless eating, or from disease or actual loss of the teeth.

IV. Natural Recovery.

We have next to enquire, whether natural recovery, as defined by us in the first chapter, ever occurs in connection with the mouth and its functions. Observation places this beyond doubt, in all the classes of disorder to which we have just referred. The sense of taste is restored after fever has gone. The secretions which have been deranged by the same cause, or by Atropia, Mercury, or Jaborandi, return to the normal quantity and quality when the disturbing influence is spent or has been removed. The excretions again become "sweet" when the substance that disordered them has been completely thrown out. The teeth present side by side with decay a process of repair, which frequently counteracts it.

There is, however, a *limit* to recovery in the mouth, as elsewhere. The teeth decay and fall out; and the other tissues may become involved in serious or hopeless disease. Even then, as we shall presently see, rational treatment is not impossible.

V. Therapeutics.

The rational treatment of diseases originating in the mouth is but the scientific application of the knowledge arranged under the previous four heads, respecting its physiology, the forces acting on the mouth which are at our command, the causes and phenomena of its derangements, and the occurrence and limits of natural recovery.

1. The *food* must always receive most careful supervision, not only in cases where it has been bad, improperly taken, or imperfectly masticated, but in every instance of disorder of digestion from whatever cause, in the mouth or other part of the alimentary canal. The details of dietetic treatment must be learned from other works.

2. The disorders of the *sensory apparatus* of the mouth very rarely call for treatment, but we have constant occasion to avail ourselves of our influence over the nerves of taste for the purpose of relieving derangements of the *secretions*. Thus deficiency of saliva, and the distressing thirst and loss of relish which attend it in fever, may be relieved either through the nerves of taste, or more directly by means of acids in the form of drinks, such as water acidulated with the Mineral Acids, Vinegar and water, Carbonic Acid in effervescing drinks, Cream of Tartar, Lemon Juice in various combinations, and acid fruits,

if not otherwise unsafe, including the Tamarind of the pharmacopœia, grapes, and oranges. Failing or instead of these, ice, sips of water, and some of the demulcents already enumerated may be given. When the deficiency of saliva, the dryness of the mouth, and the lack of relish are less urgent but more persistent, as in chronic dyspepsia, we adopt more pleasing means of stimulation. We have recourse to aromatic, bitter, spirituous, and pungent articles. We order food specially flavoured or made otherwise agreeable to the palate by artistic cookery. When the appetite flags after severe illness or in exhaustion from other causes, we recommend the patient to stimulate his palate with a little wholesome wine, which is at once acid, aromatic, and spirituous. We rouse the nerves of taste and the secreting glands by simple or aromatic bitters in acid or alcoholic combinations before or during meals, or pungent and acid condiments, such as mustard, pepper, and pickles.

3. When it is desired to rouse the gustatory and secreting functions of the mouth independently of digestion, *e.g.* in cases of paralysis of the mouth, and in the chronic thirst of Bright's disease and diabetes, such substances as Pyrethrum, Tobacco, and small doses of Pilocarpin are indicated. The dryness of the mouth and throat caused by Atropia and Hyoscyamia may require the suspension of the drug, or Jaborandi may be prescribed with it unless contra-indicated. On the other hand, salivation produced by drugs must be arrested by removal of the cause, such as Mercury, or the exhibition of Belladonna.

4. The treatment of unpleasant *excretions* from the mouth is rationally carried out by removing their cause, especially disorder of the stomach and bowels; deodorising the breath; or imparting to it an artificial odour.

5. Defects in the *mechanical apparatus* of the mouth, especially the teeth, have, as a rule, advanced beyond the limits of functional treatment. Even then treatment is not only possible, but dental surgery is one of the most rational and successful branches of local therapeutics. Short of this, much can be done by ordering food in a soft or fluid form, and directing that time and care be spent by the patient over the process of masticating, tasting, and insalivating every morsel.

Lastly, a discussion of the action of drugs upon the mouth introduces us naturally to the therapeutics of the next stage of the digestive process—in the stomach. The substances which stimulate the nerves of taste are constantly employed, as we shall see, to produce reflex activity of the gastric functions; and the thorough insalivation with the alkaline juices of the mouth, for which they also provide, may be used as a powerful means of increasing the acid secretion.

SYNOPSIS OF REMEDIES WHICH ACT UPON THE MOUTH.

BITTERS.	AROMATICS.	AROMATIC BITTERS.	SWEETS.	ACID SUBSTANCES.	DEMULCENTS.	SIALAGOGUES.	ANTI-SIALAGOGUE.
Rheum	Rosmarinum	Cascarilla	Glycyrrhiza	Pot. Tartr.	Ficus	Tabacum	Potassium
Nectandra and Beberia	Mentha Piperita	Anthemis	Glycerinum	Acida	Ulmus	Jaborandi	Soda
Aloe	Mentha Viridis	Gentiana	Saccharum	Tamarindus	Egg	Physostigma	Ammonia
Cinchona and Quinia	Cinnamomum	Chiretta	Theriaca	Limon	Hordeum	Acids	Calcium
Taraxacum	Lavandula	Lupulus	Mel	Aurantium	Tamarindus	Potassæ Tartras Acida	Lithia
Nux Vomica and Strychnia	Eucalyptus	Serpentaria	Tamarindus	Wines	Linum	Tamarindus	Magnesium
Calumba	Sambucus	Limon	Chloroformum	Acidum Sulphuricum Dilutum	Uvæ	Limon	Opium
Quassia	Rosæ	Aurantium		Acidum Nitricum Dilutum	Tragacantha	Aurantium	Belladonna
	Zingiber	Canella		Acidum Hydrochloricum Dilutum	Acacia	Prunus	Hyoscyamus
	Cardamomum	Cusparia		Acidum Nitro-Hydrochloricum Dilutum	Amygdala	Wines	Stramonium
	Myristica			Acidum Aceticum Dilutum	Cassia	Hydrargyrum	Nauseous substances
	Caryophyllum			Acetum	Water	Ioda	Insipid foods and drinks
	Oleum Cajuputi		PUNGENTS OR ACRID.	Oxymel	Ice	Antimonium	Tabacum (excess)
	Carui			Acidum Phosphoricum Dilutum	Milk	Ipecacuanha	
	Fœniculum			Acid Tartaricum	Isinglass		
	Oleum Anisi	SPIRITUOUS.	Piper (partly aromatic)	Ac. Citricum	Cetraria		
	Anethum		Cubeba ditto	Ac. Carbonicum	Syrupus		
	Coriandrum		Pyrethrum		Theriaca		
		Alcohol (in every form)	Capsicum		Mel		
	Ammoniacum	Æther	Sinapis		Amylum		
	Assafœtida	Chloroformum	Armoracia		Triticum		
	Castor		Guaiacum		Oleum Olivæ		
	Valeriana				Oleum Amygdalæ		
	Moschus						
	Sumbul						

CHAPTER III.

DIGESTION.—THE STOMACH.

I. Physiological Relations.

Gastric digestion is mainly effected by the gastric juice, an acid secretion which owes its solvent and chemical power to pepsin and hydrochloric acid. The gastric secretion is stimulated by the *mechanical* presence of food; by the *products* of digestion, part of which is rapidly absorbed; by impressions on the *nervous centres*, such as tastes, which were referred to in the previous chapter; and by the presence of saliva and other *dilute alkaline fluids* at the mouths of the tubules. During digestion the gastric vessels actively dilate; the muscles move vigorously; by the end of four hours much of the proteids have become peptones; the sugar, starch, and fats are broken down or emulsified, but remain chemically unaltered; and the whole of the products, constituting the chyme, are transferred to the duodenum.

The nervous arrangement by which the stomach is stimulated, or prepared to receive and digest food, is chiefly a local one; the contact of food, digested products, and dilute alkalies acting on ganglia in the gastric wall itself. Besides this, the stomach is connected with a *centre* in the medulla, and with the cerebrum, by means of afferent and efferent nerves—the vagus and the sympathetic. The impressions which thus reach the sensorium and the gastric centre are reflected as *impulses* to the stomach, through the efferent nerves; which also convey from the cerebrum the impulses generated by sensations of taste, as we saw in the last chapter, as well as by the smell, sight, or idea of food. Besides these, numerous impressions from the intestines, liver, kidneys, and generative organs, indeed from all impressionable parts whatsoever, influence the stomach by being reflected to it through its centre in the medulla. The influence of these nervous impulses upon the stomach is very marked. They affect the secreting glands, the vessels, and the muscles, exciting, arresting, or otherwise modifying, as the case may be, the secretion of gastric juice; and under certain circumstances they give rise to vomiting.

II. Pharmacodynamics.

We have now to inquire how many of the conditions which influence gastric digestion are under our control: how far we can act physiologically on the stomach.

1. We have complete power over all that enters the stomach in the form of *food* and drink, and much influence, as we have seen, over salivary digestion. Even if the food have left the mouth and reached the stomach, we can evacuate its contents by means of the pump, or by the use of emetics, which will be considered in chapter iv.

2. As regards the *gastric juice*, we can increase its flow in many ways. We can irritate the tubules mechanically by the character of the food, making it more or less solid as may be required. We may provide, as the first part of the meal, substances, such as soup, which will be rapidly peptonised and absorbed, and stimulate the follicles to abundant secretion. We can subject the secretion to nervous influences which are at our command, such as the agreeable sensations of taste, which are aroused by artistic cookery, wholesome condiments, and grateful wines, as well as by pleasing associations during meals. The activity of the glands may be increased through the medium of the local circulation by various means to be presently described. Further, we can provide for moderate alkalinity of the contents of the stomach, by increasing the salivary flow. The same end may be secured more certainly by the administration of dilute alkaline solutions before meals, such as Bicarbonate of Soda, Sal-volatile, or Liquor Potassæ, which are amongst the most useful and generally employed of remedies, and constitute the **alkaline stomachics**. We can go even farther than this, and modify the amount either of the pepsin, or of the hydrochloric acid, or of both, by giving them along with the food, and thus constituting them **digestive adjuvants**.

3. The activity of the *nerves* of the stomach is readily influenced in either direction. We may increase their sensibility by administering the same series of hot substances which we studied in the mouth, such as Alcohol, Aromatic Oils, Pepper, and Mustard; the effect being not confined to a sense of warmth in the epigastrium, but extending to stimulation of the local, and even the general circulation, and the associated nervous structures, as we shall presently see. These substances, as well as the aromatic bitters, such as Gentian or Orange, and the simple bitters, such as Calumba, have the effect of stimulating the nerves, dilating the vessels, and possibly increasing the activity of the glands and muscles of the stomach, whilst they create the sensation of hunger, probably by setting up these changes in the gastric wall. They form, therefore, other groups of stomachics, **the aromatic, spirituous, bitter** and **pungent stomachics**. On the contrary, we may appease the sense of hunger by such artificial means as tobacco smoking.

Equally powerful is the influence of many substances and measures, as **gastric sedatives**, in reducing the sensibility of the afferent nerves, and thus interfering with gastric sensations, and the gastric functions which depend upon the reflection of impressions. Opium is thus all-powerful in preventing or relieving pain in the stomach, and in arresting the gastric secretions and movements. Diluted Hydrocyanic Acid and Belladonna and its allies, also act in this way; as well as Carbonic Acid in the form of effervescence; and water, either as hot as it can be drunk or in the form of ice. Bismuth, whether considered mechanically or physiologically is uncertain; and Oxalate of Cerium is in a manner still obscure. A number of drugs remove causes of irritation, and are thus gastric sedatives, such as Oxide of Silver, Creasote, and Carbolic Acid, which arrest disorder of the mucous membrane. Various applications to the epigastrium, including poultices, fomentations, and blisters, afford a convenient means of soothing the gastric nerves reflexly through the nervous centres.

4. The *circulation* in the stomach is also so far under our control, as we have already seen. The many substances which stimulate the nerves also redden the surface of the mucous membrane, by dilating the vessels and increasing the local blood flow within physiological limits, such as Alcohol, Ether, Aromatic and Pungent articles (Pepper, Mustard, Capsicum, etc.), and Bitters. Besides these, there are numerous substances of a more powerfully irritant nature which we note chiefly for the purpose of suggesting caution in their employment for other purposes. Arsenic, Iron, Mercury, and indeed the salts of most of the metals: Senega, Digitalis, and Scilla; Colchicum and Veratria, are examples of drugs which are specially apt to derange digestion. On the other hand, the local circulation can be rendered less active by means of Acids; salts of Silver, Zinc, Lead, in small doses; Ergot, Opium, Tannic Acid, and the many vegetable astringents containing it, such as Kino, Catechu, and Cinnamon. These are **gastric astringents**, and indirectly, therefore, another class of *gastric sedatives*.

5. The *movements* of the stomach can be readily modified. The energy of the churning movements increases with the acidity of the chyme, and we can take advantage of this knowledge by administering acids after meals, such as Diluted Nitric, Hydrochloric, or Nitrohydrochloric Acids, which are thus another class of *gastric stimulants*, sometimes called **gastric or stomachic tonics**. Specific nervo-muscular stimulants, such as Strychnia, probably act in the same way, as well as the stimulants of the nerves and vessels, especially Ether and Volatile Oils. That powerful excitation of the movements of

the stomach which is called emesis or vomiting, will be specially described in the next chapter.

Per contra, the gastric movements may be directly diminished by Diluted Hydrocyanic Acid, Opium and Morphia, Carbonic Acid and all effervescing drinks; by the Alkalies, which reduce acidity; as well as indirectly by remedies which soothe the nerves and the vessels, as we have seen.

6. We have already referred to our influence on the *contents* of the stomach—to the food, and to the acidity of the chyme. The reaction may be neutralised or completely changed by Alkalies or Alkaline earths, which are thus **antacids**. Beyond these, Charcoal absorbs the gaseous products of digestion; whilst Sulphurous Acid, Sulphites and Hyposulphites, Carbolic Acid, Creasote, the Aromatic Oils, and possibly all Bitters and Vegetable Astringents in some degree correct decomposition—**gastric disinfectants**. In this connection mention must be made of many **antidotes**, which act upon poisons in the stomach.

7. *Action of carminatives.*—The effects of Aromatic and Pungent Oils of Alcohol, and Ether, in rousing the nerves of the stomach, in increasing the activity of the gastric circulation, in exciting muscular contraction, and in modifying the contents, have been separately described; and we may add that they probably at the same time relax the cardiac orifice. The result is eructation, and relief of gaseous distention, of cramps and pain, the whole being so striking and complete that these substances have been grouped together under the special name of **carminatives** (*carmino*, I soothe). Their effect is, however, more than local. The nervous impressions produced by carminatives spread even beyond the stomach and its sympathetic ganglia to the cord, medulla, and brain, and reflexly to the heart and vessels, and cause general stimulation, both of the bodily and the mental faculties. Carminatives are thus one form of *diffusible stimulants*.

III. Pathological Relations.

Derangement of gastric digestion, or dyspepsia, is probably the most common disorder of the human body, and may be taken to illustrate, in a general way, the rational treatment of diseases of the stomach.

By far the most frequent causes of derangement of the stomach are to be found in the quantity and quality of the food; in its imperfect mastication and insalivation; in deficiency or in excess of fluids, which dilute the gastric juice and check secretion; and in the abuse of alcohol. Certain drugs in common use are also apt to cause indigestion, such as Opium, Arsenic, Iron, Digitalis, and Scilla. Organic disease of

the stomach itself necessarily leads to the same result. Excess of the gastric juice is rare. As a rule, the juice is deficient in relation to the amount of food taken, whether from excess of the latter or from absolute diminution in the secretion, for instance, in debility after illness. Again, either the pepsin or the hydrochloric acid may be deficient, or impeded in its special action. Gastric indigestion is occasionally of nervous origin: depressing mental states readily arrest the action of the stomach; and morbid impressions, originating in the liver, intestines, kidneys, or uterus, often have the same effect.

Disorder of the muscular functions of the stomach may also cause dyspepsia. Feebleness of the churning movements leads to imperfect exposure of the food to the action of the juice; feebleness of the expulsive efforts delays the removal of the chyme, *excess of which arrests digestion*. In other cases, excessive peristalsis hurries the food into the duodenum before the process of gastric digestion has well commenced.

If from any of these or from other causes, the contact of the food and the gastric juice be deficient, the process of digestion becomes disturbed. The secretion, unable to effect complete conversion of the proteids into peptones, produces some partial chemical change in them; the other constituents of the food are also broken up; and—what with the unnatural products, and, in the case of a heavy meal, the excess of peptones themselves—the process of digestion is completely arrested. A decomposition occurs, associated with the formation of organic acids; the sugar, starch, and fat probably become partially changed; and the contents of the stomach are converted—not into the normal chyme, but into a sour, fermenting mass with abundant development of gas. The stomach becomes distended, and the neighbouring organs impeded in their action, especially the heart. The nerves, vessels, and glands of the stomach are irritated by the products, so that the mucous membrane swells; the rosy hue passes into pallor; and the surface is coated with a tenacious mucus. The gastric and associated centres are powerfully excited; and impulses are sent out which lead to hiccup, eructation, and vomiting. If these do not give relief, the contents pass into the bowel, irritate it also by their excessive acidity, and give rise to duodenal dyspepsia and diarrhœa. Even when the urgent symptoms have subsided, the morbid anatomical condition remains for a time associated with an excessive secretion of mucus; the digestive power is arrested; pain and fulness are felt; and loss of appetite (anorexia) and nausea are complained of. All these symptoms will call for relief by treatment.

In *chronic dyspepsia* the attacks are much less severe, but

practically continuous. This often depends on other morbid states of the stomach such as cancer; or on disease of other organs, for instance, the kidney, or of the system generally, such as gout, or tuberculosis. The muscular power of the stomach also becomes weak in chronic dyspepsia, the peristaltic movements less vigorous, the organ possibly dilated, and the action of the orifices disordered.

IV. Natural Recovery.

Acute dyspepsia generally passes off within so many hours or days if left entirely without treatment, vomiting being obviously a natural provision for its relief, and the subsequent nausea or anorexia a means of preventing the introduction of fresh food and affording the stomach temporary rest. These are valuable suggestions for treatment. The duration and degree of suffering in acute indigestion may, however, be considerable; and the violence of the symptoms, such as vomiting, may lead to injury or permanent disease. Therapeutical interference is therefore essential. Organic diseases of the stomach are frequently beyond treatment in themselves, but most of the distressing symptoms by which they are attended, are perfectly capable of relief.

V. Therapeutics.

The conclusion to be drawn from the considerations in the preceding sections is manifestly to the effect that certain disorders and diseases of the stomach are capable of rational treatment.

1. *Prophylactic Treatment.*—Prevention is essentially the proper means of treating dyspepsia. The common causes of disorder, and the opportunity of removing them, are constantly at hand. Prevention here lies almost entirely in the direction of diet, and includes care with respect to the quantity and quality of the food, the frequency and general arrangement of the meals, the circumstances, social and otherwise, under which the food is taken, the thorough performance of digestion in the mouth, the amount of fluids with meals, including alcohol, and other matters which do not call for discussion here. *Dieting is the most important part of the treatment of indigestion:* without attention to it, medicinal treatment is of no avail.

Next to the food, the most ready, but not the most advisable, means of preventing dyspepsia is furnished by the gastric juice itself, or its important constituents, artificially administered. Hydrochloric Acid and Pepsin may be given alone or combined, either during or immediately after meals; or the food may be previously peptonised by the addition to it in the process

of cooking, of a digestive extract, made from the mucous membrane of the stomach, or from the pancreas, of the calf or pig.

The therapeutist should endeavour, however, to adopt a much less artificial method of treatment than this. He should try to call into play some of the influences to which the gastric flow is peculiarly sensitive, and thus to increase the natural juice, instead of borrowing its constituents from other sources. First, he will ensure a certain mechanical effect of the food on the stomach, by seeing that "slops" are not indulged in, at the same time remembering that a small quantity of a warm nutritive fluid dish, such as soup, which will be quickly absorbed and stimulate the follicles, is the best commencement of a considerable meal. Drugs will also be prescribed. The most powerful medicinal stimulants of gastric activity must reach the stomach distinctly before meals. Those which increase the activity of the nerves and vessels, and indirectly the activity of the glands and muscles, namely alcoholic, aromatic, bitter and pungent stomachics, are best given in combination, *e.g.* the tinctures of Gentian, Orange, Cascarilla, Chiretta, etc., variously combined with spirits such as Spiritus Ammoniæ Aromaticus, Spiritus Myristicæ, Spiritus Armoraceæ, or Spiritus Chloroformi. A still more powerful gastric stimulant is to be combined with these, viz. an alkaline stomachic, in the form of a preparation of Potash, Soda, or Ammonia, the Bicarbonate of Soda being, for many reasons, the salt most frequently selected. Let it be carefully noted that the alkali must be given with the aromatic bitters, *shortly before meals.* This constitutes the routine medicinal treatment of dyspepsia, and we may repeat that the same result is obtained by successful insalivation of the food, of which the method is but an artificial imitation. The mental occupation and general surroundings of the patient, as well as the times and amount of physical exercise with relation to meals, will also require to be carefully regulated.

2. *Immediate treatment.*—If acute dyspepsia be actually present, it is too late to attempt to stimulate the gastric flow. We must make our choice whether we shall evacuate the stomach, or neutralise the acidity and absorb the gas which are causing the distress. The use of emetics will be described in the next chapter. If the alternative measure be chosen, we give a dose of alkali or an alkaline earth—not, let it be observed, as an alkaline stomachic, but purely as an *antacid to the contents* of the stomach. Bicarbonate of Soda is again the means commonly chosen for the purpose, combined probably with Carbonate of Ammonia and an aromatic oil, such as Peppermint or Ginger,

or more elegantly with Spiritus Ammoniæ Aromaticus, to act as a carminative. The result is that the acidity of the contents is reduced—and it is remarkable how small may be the quantity of alkali required for this purpose—so that the mass passes with comparative safety into the duodenum. Instead of Soda, Magnesia or its Carbonate is occasionally used as an antacid, which, being also a purgative, hastens the expulsion of the offending contents. Gas may be partly absorbed by charcoal, given in powder or in the form of lozenges or biscuits, and partly removed by eructation induced by the carminative, which will further help to arrest decomposition, relieve pain, and rouse the heart and nervous system from the state of depression caused by the attack.

3. *Treatment of the effects.*—When the process of indigestion is at an end, and prostration requires to be relieved, the therapeutist will avail himself of some of the many gastric sedatives at his disposal, of which Diluted Hydrocyanic Acid, Bismuth, and Morphia (whether given subcutaneously, applied to the epigastrium endermically, or combined in an effervescing mixture) will be found the most useful. Champagne or effervescing Soda-Water and Brandy will serve at once as a gastric sedative and a general stimulant, or Milk with Lime-Water or Soda-Water may be given as a sedative and nutritive. Ice is the best means of relieving thirst; in other cases water as hot as can be drunk often acts as a valuable sedative. Linseed poultices, hot fomentations, or warm compresses may be ordered to the epigastrium, and in severe and persistent cases Mustard or Cantharides blisters. The chief problem will be to support the strength without increasing the pain and sickness, and in very urgent cases the patient must be fed by the rectum.

The greatest caution must be exercised in resuming gastric digestion. The best treatment, unless the patient be very weak, is to rest the stomach absolutely for many hours. Fortunately, anorexia conduces to secure this end. The first food given should be in the smallest possible bulk, and of the blandest and most digestible kind, such as broths, essences, meat juices, and milk; and just before each meal a small dose of a mixed stomachic, such as Bicarbonate of Soda, with Diluted Hydrocyanic Acid or Bismuth, and a mild aromatic bitter, such as Gentian, should be prescribed, which will restore the secretion of gastric juice and arrest the flow of alkaline mucus set up by the dyspepsia.

4. *Chronic Dyspepsia* is rationally treated on the same principles as the acute form of the disorder, with certain modifications, which a careful consideration of the pathological associations of the particular case and general experience will suggest. The

patient's diet will require constant supervision. The possible causes of indigestion, beyond food, must be searched for, such as disorder of the liver or bowels, of the heart or kidneys, gout or tuberculosis, and the treatment must be arranged accordingly.

The flow of juice may still require stimulating by Alkalies, but these remedies must not be overdone, as they tend to depress the muscular and cardiac energy. The *digestive adjuvants*, Pepsin or Diluted Hydrochloric Acid or both, may now more rationally be brought to the relief of the failing secretion, being given during or at the end of meals. In still more chronic cases, *e.g.* in aged persons, where chronic indigestion depends on wasting of the glandular structures, peptonised foods will be of great service. In most cases of chronic dyspepsia, the nervo-muscular structures of the stomach require to be strengthened, and distension or overfulness of the organ avoided. Flatulent substances must be excluded from the diet, such as green vegetables, sweets, sloppy food, and large draughts of strong, hot tea. Powerful bitters, such as Strychnia and Quinia, the former being peculiarly valuable as a specific nervo-muscular stimulant, and Diluted Nitric and Phosphoric acids—in short, *stomachic tonics*—are given to increase the functional and nutritive vigour of the muscular coat. In some of these cases *gastric disinfectants*, such as Creasote and the Sulphites or Hyposulphites, may be required to cleanse the contents and surface of the organ, and destroy the organisms of putrefactive and fermentive processes.

Chronic dyspeptics always suffer from starvation to a degree, and the food selected for them must be nutritious as well as digestible. Alcohol in proper form and amount may be required, and bland preparations of Iron, such as the Ammonio-citrate, ordered at intervals, if they can be taken without increasing the dyspepsia. If the dyspepsia depend on a chronic catarrh of the stomach with excessive secretion of mucus, *gastric astringents* will manifestly be indicated, such as Oxide of Silver or Zinc, or Kino, Cinnamon, and other substances containing Tannin.

The treatment of *organic disease* of the stomach cannot be discussed here, but it is hoped that the student will understand from what he has learned, the principles which he must follow to fulfil the most urgent indications in this class of cases also: to relieve pain and sickness, and to insure functional rest of the stomach, remembering that many of the symptoms are referable to dyspepsia.

The therapeutics of vomiting, and incidentally of certain other associated disorders of the stomach, will be discussed in the next chapter.

Synopsis of Drugs which act upon the Stomach.

Alkaline Stomachics.

Liquor Potassæ
Potassæ Bicarb.
Sodæ Bicarb.
Ammoniæ Carb.
Spiritus Ammon. Aromaticus
Magnesia
Magnesia Levis
Magnesiæ Carbonas
Magnesiæ Carbonas Levis

Bitter Stomachics.

As in the Mouth

Aromatic Stomachics.

As in the Mouth

Aromatic-Bitter Stomachics.

As in the Mouth

Spirituous Stomachics.

Alcohol (in all forms)
Ether
Chloroform

Acid Stomachics.

Acidum Sulphuricum Dilutum
Acidum Hydrochloricum Dilutum
Acidum Nitricum Dilutum
Acidum Nitro-Hydrochloricum Dilutum
Acidum Phosphoricum Dilutum
Acidum Aceticum

Pungent Stomachics.

Piper
Cubeba
Capsicum
Sinapis
Armoracea

Nervo-Muscular Stimulants, or Stomachic Tonics

Mineral Acids
Nux Vomica
Strychnia
Bitter Stomachics
Aromatic Stomachics
Bitter Aromatic Stomachics
Spirituous Stomachics
Pungent Stomachics

Stimulants, becoming Irritants and Emetics.

Iodum
Tabacum (in excess)
Scilla
Digitalis
Veratria
Colchicum
Senega
Copaiba
Cambogia
Guaiacum
Ferrum
Hydrargyrum
Arsenicum

Digestive Adjuvants

Pepsina
Acid Hydrochloricum Dilutum

Nervo-Muscular Depressants.

Hot Water
Belladonna
Hyoscyamus
Stramonium
Acidum Hydrocyanicum
Opium
Carbonic Acid
Ice
Tabacum (at first)

Gastric Astringents.

Acid. Tannic.
Argenti Oxidum
Plumbi Acetas
Zinci Oxidum

Antacids.

Potassa
Soda
Lithia
Ammonia
Calcium
Magnesia

Mechanical Sedatives.

Bismuthi Carbonas
Bismuthi Subnitras

Sedatives of Obscure Action.

Cerii Oxalas
Ipecacuanha

Gastric Disinfectants.

Carbo
Tannicum
Creasota
Acidum Sulphurosum
Sulphite of Soda
Hypo-Sulphite of Soda

Carminatives.

Camphora
Serpentaria
Assafœtida
Ammoniacum
Valeriana

All Aromatics
Aromatic Bitters
Spirituous Stomachics
Pungent Stomachics

CHAPTER IV.

EMETICS AND VOMITING.

I. Physiological Relations.

Vomiting is a complex act, in which the respiratory muscles, the abdominal walls, the walls of the stomach, the sphincter of the cardiac orifice, and the œsophagus and pharynx participate. Occasionally it is to be regarded as a strictly physiological process for removing excess of food from the stomach, as in the regular sickness of infants after a full meal of milk. It is determined and directed by an elaborate nervous mechanism, consisting of a special centre, the *vomiting centre*, in the medulla; of *afferent* nerves from the fauces, stomach, abdominal viscera, and peritoneum, the chief of which are the glosso-pharyngeal, vagus, and sympathetic, and, indeed, from other parts of the body—the sensory nerves generally; and of *efferent* nerves (the vagus, phrenic, and intercostals) to the muscles, cardiac orifice, and certain associated parts to be presently mentioned. Vomiting may be induced by impressions originating in the areæ supplied by any of the afferent nerves; by stimulation of the centre by certain substances which reach it through the blood; or by the downward flow to it of certain mental impressions, such as nauseous tastes, foul smells, disgusting or terrifying sights, and depressing ideas.

With the evacuation of the stomach there occur certain *associated acts* which are of great importance to the therapeutist. A flow of saliva may precede vomiting, as is well seen in some reflex cases. The gall bladder may be forcibly emptied of bile, which regurgitates into the stomach and is vomited. Expiratory movements, such as sneezing and coughing, frequently occur at the beginning of sickness, indicating the spread of the stimulant impressions to the associated respiratory centre in the medulla; and it must be carefully observed that an expiratory effect is also produced by compression of the chest during the evacuation of the contents of the stomach, as well as at the end of the act, when the air is forcibly expelled through the larynx to prevent the entrance of solid particles. Thus vomiting tends to empty the respiratory passages, as well as the upper part of the alimentary canal. The stimulant effect of emetics on the salivary flow is frequently accompanied by a secretion of bronchial mucus; and this being expelled by the upward current of air, tends further to clear the passages.

Whilst the respiratory and gastric centres are thus powerfully stimulated in vomiting, the cardiac and vascular centres are greatly depressed, the action of the heart and the pulse being reduced in force—at least, between the acts of sickness, and a sense of faintness and giddiness overspreading the patient from further cerebral anæmia. At the same time, the motor centres in the brain, and probably in the cord, are lowered, leading to prostration and inability to support the weight of the body, and compelling recumbency. Lastly, the centres of perspiration are stimulated, causing the profuse sweating familiar in many cases of sickness. Altogether, the student will appreciate how extensive is the physiological disturbance produced by vomiting, and how great is the influence which it furnishes us over several of the most important functions of the body.

II. Pharmacodynamics.

Vomiting may be excited by certain substances and measures, which are called **emetics**. Emetics are said to be either (1) **direct**, when they act upon the stomach itself; or (2) **indirect**, when they act upon the vomiting centre or some other part of the nervous mechanism. *Direct* emetics are the larger of the two classes. They include *warm* water, Infusion of Chamomile, Salt and Water, Mustard, Carbonate of Ammonia, Sulphate of Zinc, Alum, and Sulphate of Copper. They are necessarily given by the mouth. *Indirect* emetics are a small group of drugs, including only Ipecacuanha, Antimony, and Apomorphia. These excite vomiting by whatever channel they may be admitted into the blood—subcutaneously, by the mouth, or by the rectum. For the same reason they produce greater general depression, that is, depress the other vital centres in the medulla more than moderate doses of the direct emetics. Physical irritation of the fauces is a ready emetic measure of the indirect class; and nauseous drugs, such as castor oil and rhubarb, frequently act on the nerves of the same part, but are not given with this intention. Ipecacuanha and Antimony act on the stomach as well as on the centre, and are really, therefore, **direct and indirect emetics.**

The means at our disposal for *averting or arresting vomiting* are as various as the parts of the extensive mechanism upon which they act. They may be called **anti-emetics.** First of these may be mentioned the measures which *reduce the irritability of the vomiting centre*, such as the recumbent posture, nourishing food, Amyl-Nitrite, Nitro-Glycerine, Alcohol, Opium, Chloral, the Bromides, and Diluted Hydrocyanic Acid. A second class, more readily available, comprise the *sedatives of*

the afferent nerves from the stomach, such as *Hot* Water, Ice, Diluted Hydrocyanic Acid, Carbonic Acid, Bismuth, Dilute Alkalies, Opium, Ipecacuanha and Calomel in small doses; measures which act *indirectly* upon the stomach and reduce the irritability of its nerves, such as poultices or blisters to the epigastrium; and *sedatives of the afferent nerves to the vomiting centre from other organs*, for instance, demulcents to the throat, poultices to the abdomen, or applications to the os uteri.

III. Pathological Relations.

Vomiting being regarded for our present purpose as a physiological act, it may be considered to be disordered, (1) if *excessive;* and (2) if *defective, insufficient, or absent* when it would be salutary or desirable. We will illustrate each of these conditions.

1. *Excessive vomiting* occurs as the result of disorder or disease of the stomach; morbid conditions of other parts of the abdomen, such as hernia, cough, severe pain, injury or disease of the brain, or disturbance of the circulation and senses, including sea-sickness. The cause of vomiting may be in the centre itself, especially as a consequence of previous violent vomiting, or of urea and certain extrinsic poisons, such as antimony.

2. *Defective vomiting* may be said to occur when only attempts at retching ensue on the presence of direct or indirect stimulation of the centre. In the vast majority of cases, however, we have to deal with conditions in which, whilst vomiting is urgently demanded, no attempt at vomiting is made by nature, the substances which require to be expelled from the stomach being of a non-irritant or even sedative nature, such as narcotic poisons. This introduces us, further, to the use of emetics for other purposes than simple evacuation of the stomach. Vomiting may be desired for the sake of obtaining one or more of the associated effects on other viscera. In certain inflammatory diseases of the larynx and bronchi, such as croup and bronchitis, which are attended by the production of thick or solid products, or whooping cough, which is characterised by defective or disordered expulsive power, an emetic will be indicated to empty the respiratory passages and restore the free entrance of air. Similarly, rigidity of the cervix uteri in the first stage of labour is believed by some obstetricians to call for emetics which shall relax the uterine sphincter.

IV. Natural Recovery.

Vomiting usually ceases with the removal of its cause, but it may persist indefinitely, until the therapeutist steps in.

Whilst it is in itself a natural provision for relief, there is a limit to its beneficial effect. Protracted vomiting appears to increase the irritability of the mucous membrane and nerves of the stomach, and thus to tend to go from bad to worse; and the same is the case with the vomiting centre, which may become so sensitive as a consequence of sickness that the slightest change of posture brings on the symptom afresh. There is urgent need for treatment in such cases.

V. Therapeutics.

The therapeutical relations of vomiting, rationally considered, are obvious. Excessive vomiting has to be arrested; vomiting may have to be assisted when it is ineffectual, or excited when entirely absent; and the action of emetics may be taken advantage of for other purposes than to empty the stomach.

1. *Excessive Vomiting.*—The study of the physiology and pathology of vomiting serves to impress upon the student the absolute necessity for diagnosis, or investigation of the cause of disorder, before rational therapeutics can be carried out, and the thoroughly unscientific and unsatisfactory character of the practice which applies treatment to symptoms without ascertaining the pathological condition on which they depend. How extremely irrational it would be to attempt to relieve by the same means the vomiting caused by indigestible food at the commencement of acute indigestion, and the vomiting due to the swelling which persists in the second stage. At the former period, vomiting is relieved by temporarily encouraging it by a good emetic; at the second period, the very opposite set of measures—gastric sedatives—must be employed.

The first step to be taken manifestly is to attempt to *remove the originating cause* of the reflex act. If the stomach contain irritant food, it must be quickly neutralised, as we saw in the last chapter; if a poison, some antidote must immediately be administered; or either of the two may be removed from the stomach by facilitating and completing vomiting, or by means of the pump. Once emptied, the stomach must be quieted by the gastric sedatives studied in the last chapter. If the cause be discovered in any of the other abdominal organs, the same plan of removal, if possible, must be pursued. Vomiting originating in injury or disease of the brain will call for the special treatment proper in such cases, and the free use of nervous sedatives, such as the Bromides of Potassium and Ammonium. If the vomiting centre is being irritated by some intrinsic poison such as urea, or an extrinsic poison such as antimony, the excretion of the morbid substance by the kidneys, skin, or bowels, must be hastened, or its effects antagonised by stimulants.

If, on the other hand, disturbance of the circulation in the centre be the cause of the vomiting, we must restore the normal supply of blood by keeping the patient in the recumbent posture and insuring bodily rest, and stimulate the circulation by Alcohol and food, if they can be retained in the stomach. Nitro-glycerine, Nitrite of Amyl, and Chloral appear to have been given with some success under these circumstances.

When the cause cannot be removed we must reduce the irritability of the centre by Opium or similar drugs.

2. *Defective Vomiting: Use of Emetics.*—The adoption of vomiting as a therapeutic measure, and the selection of an emetic from the list just given, are matters of the greatest practical importance. The student must not think that in inducing vomiting we are effecting a simple mechanical act of evacuation; he must appreciate the extent and degree of physiological disturbance which we are setting up. If the patient be very weak, the therapeutist may be alarmed to find that his emetics or unsuccessful attempts at emesis are followed by intense circulatory depression, faintness, and even threatening dissolution. The condition of the patient must be carefully, if quickly, ascertained; and if vomiting be considered a justifiable and proper method of treatment, a selection must be made of one or other emetic, according to the patient's strength and other circumstances. Fortunately, in most cases of acute poisoning, where vomiting is urgently indicated, the patient is able to bear the shock, and Sulphate of Zinc, twenty grains in two ounces water, Sulphate of Copper, two to five grains in an ounce of water, or a table-spoonful of Mustard in a cupful of hot water, should be given without delay. Where blocking of the respiratory passages by the products of croup or bronchitis calls for an emetic, great judgment is required to estimate the patient's strength and to select a proper emetic, if any. Vinum Ipecacuanhæ, in doses of 1 fl.dr. for children, or ½ fl.oz. for adults, is the best, because it is also an expectorant. Antimony is decidedly more depressing, in doses of 1 to 2 gr. of Tartarated Antimony, or ½ fl.oz. of Vinum Antimoniale for an adult. Carbonate of Ammonia is a suitable emetic in these cases, being a stimulant to the heart and respiration. In acute dyspepsia the mildest emetics are indicated, including tepid water, Salt and water, warm nauseous infusions such as Chamomile; and may be freely given. Apomorphia is at once the most certain and generally applicable, whilst the least employed of emetics, because rarely at hand. $\frac{1}{10}$ gr. may be given subcutaneously, or a dose of ½ gr. by the mouth. It is frequently necessary to follow an emetic by a stimulant, such as alcohol.

Synopsis of Remedies which Influence Vomiting.

EMETICS.			ANTI-EMETICS.	
Direct.	Indirect.	Direct and Indirect.		
Anthemis	Apomorphia	Antimonium Tartaratum	Acting through the centre.	Opium
Sinapis		Ipecacuanha		Ammonii Bromidum
Ammoniæ Carbonas				Potassii Bromidum
Alumen				Chloral Hydras
Cupri Sulphas				Alcohol
Zinci Sulphas				Food
Sodii Chloridum				Amyl Nitris
Tepid Water				Nitro-Glycerine
				Acidum Hydrocyanicum Dilutum
			Acting through the gastric nerves.	Hot Water
				Acidum Hydrocyanicum Dilutum
				Carbonic Acid
				Bismuthum
				Dilute Alkalies
				Opium
				Ipecacuanha (in small doses)
				Calomel (in small doses)

CHAPTER V.

DIGESTION—THE DUODENUM.

We are now in a position to follow the process of digestion in the duodenum. The other functions of the intestine will be considered in the next chapter.

I. Physiological Relations.

The chyme passes out of the stomach with an acid reaction, and its undigested constituents are at once subjected to a second process of digestion in the duodenum by an *alkaline* fluid, which is a mixture of the pancreatic juice, the bile, and the enteric juice. The pancreatic juice converts the remaining starch into sugars, and the remaining proteids into peptones, leucin, tyrosin, and fatty acids; whilst in association with the bile it partly emulsifies and partly saponifies the fats. The sugars are converted into lactic acid and butyric acid, possibly in part by the succus entericus, which is also amylolytic. These products of duodenal digestion, as well as those of gastric

digestion, are absorbed into the portal and lymphatic systems; whilst the undigested portions of the food and various excretions are further acted on by the bowel, and become the fæces.

Just as the acid gastric juice was stimulated to flow by the alkaline reaction of the insalivated food, so the three great alkaline secretions entering the intestine are stimulated to flow by the acid chyme. Moderate acidity of the contents, as they enter the duodenum, is manifestly the most favourable to intestinal digestion, excessive acidity tending to neutralise the alkaline fluids, and render them inert.

The nervous mechanism which regulates each of the three secretions is comparatively obscure; but they appear to be governed, like the gastric functions, both by local ganglia and by centres in the medulla, between which and the viscera there pass the vagus and sympathetic, as afferent and efferent, nerves. The vessels of the parts, so far as is known, are dilated during functional activity. The muscular movements are still, as in the stomach, partly progressive and partly churning, but the former decidedly preponderate.

II. Pharmacodynamics.

In pursuing the contents of the alimentary canal from the stomach into the duodenum, the pharmacologist becomes conscious of a decided loss of control over them when they have passed the pylorus. The chyme is now practically beyond recall upwards by vomiting; and the chemical or physiological effects which could be produced by drugs in the mouth and stomach can only be imperfectly copied in the intestines. Yet a closer examination of the influences on duodenal digestion which are in our power is reassuring.

The *food* can be modified in any direction we may think fit, and the proportion of fatty and starchy principles specially arranged to affect intestinal digestion; or the liver, pancreas, and duodenal glands may be allowed to enjoy physiological rest by abstinence from food. The food may be specially cooked in combination with an extract of pancreas and an alkali, and thus thoroughly "peptonised" or pancreatised before it is taken. Starch may be partly converted into maltose and dextrin—Extract of Malt or maltine. If evacuation of the duodenum by the mouth be practically impossible, we may expel its contents downwards by the use of purgatives, which will be presently studied.

A more complex problem meets us when we attempt to affect the *secretions* of the liver, pancreas, and intestinal glands. We cannot directly increase the alkalinity of the secretions, as we increase the acidity of the gastric juice by a dose of diluted hydrochloric acid after meals; for any alkali given

by the mouth is neutralised in the stomach before it reaches the duodenum. For the same reason we cannot administer pancreatic juice by the mouth as we can give pepsin, for its ferment is destroyed at once in the stomach. Malt extract contains an amount of active diastase, which, however, is also destroyed in the stomach, unless the extract be given at the very end of gastric digestion, when the acid is exhausted. We possess, however, equally physiological and less artificial means for stimulating the duodenal secretions. First, by influencing gastric digestion we can transmit the chyme into the duodenum with greater acidity, an **indirect duodenal stimulant** measure. Secondly, acids, such as Diluted Nitric, Nitro-hydrochloric, or Phosphoric Acid, given after meals, will be conveyed in the chyme to the mouths of the ducts, and act as **direct duodenal stimulants**; and it is possible that these may have a further influence in the same direction by being absorbed from the stomach and reaching the liver and pancreas through the blood. Ether is believed by some to stimulate the pancreas, and probably assists in emulsifying oils. On the other hand, an alkali given before meals will stimulate duodenal digestion by improving gastric digestion; whilst an alkali given after meals would interfere with duodenal digestion by diminishing the natural and necessary acidity of the chyme.

We possess a considerable number of substances which increase the flow of bile, which are designated **cholagogues**. Cholagogues are either *direct*, when they act upon the liver itself; or *indirect*, when they stimulate the liver by sweeping the intestinal bile out of the body. These facts may be accepted temporarily in connection with the digestive function of the bile; they will be fully discussed along with the purgative function of the bile in the sixth chapter. Mercurials not only clear the duodenum of chyme and bile, and furnish it with a supply freshly secreted, but also stimulate the duodenal glands, and thus have a remarkably stimulant influence on digestion.

III. Pathological Relations.

Duodenal dyspepsia is not uncommon, and may be either *secondary* or *primary*. The *secondary* form is the necessary consequence of gastric indigestion. The acid decomposing mass which passes the pylorus in acute gastric dyspepsia completely neutralises the alkaline secretions of the duodenum; the remaining proteids, fats, starches, and sugars, undergo further decomposition, instead of the proper chemical transformation; absorption is arrested; the peristaltic movements are unnaturally increased; and the contents are hurried through the bowel, and violently expelled—the whole constituting the

diarrhœa of acute indigestion, familiar to all. At the same time, pain is felt in the abdomen as the result of the powerful impressions on the afferent nerves, attended by a sense of misery and depression. *Primary* acute duodenal dyspepsia closely resembles the disorder just described, except that it is not preceded by gastric symptoms, and constitutes another form of diarrhœa. As in the case of the stomach, the chief cause of the derangement is improper feeding, including excess of those principles which tax the activity of the liver and pancreas, namely, fats, sugars, and, in infants, starchy materials. In other instances, the bile may be deficient. The flow of pancreatic juice is sometimes diminished by nausea and vomiting, as well as by other circumstances. Nervous and mental depression also interfere with the action of the secreting glands, and may lead to indigestion and diarrhœa.

In chronic cases disturbance of the natural relations between the duodenal juices and the chyme produces less urgent symptoms, but leads to more serious impairment of nutrition. Pain, "heart-burn," and depression, come on within a few hours after meals. The bowels are irregularly moved; and the motions are apt to be pale and foul, and may contain undigested fat and milk. The same symptoms in an aggravated form accompany organic disease of the duodenum, liver, and pancreas. Disorders and diseases of the liver have, however, an interest much beyond their bearing on digestion, and will be separately discussed.

IV. Natural Recovery.

Little requires to be said under this head. Diarrhœa is manifestly a natural provision for relieving the duodenum of unsuitable contents, as vomiting relieves the stomach. Even if this be excessive, and give rise to general disturbance, the duodenal function soon becomes normal, when the cause of disorder has been removed. A thorough appreciation of all the facts of the case manifestly suggests that the province of the therapeutist is not to prevent or check these salutary efforts unless excessive; and to help Nature to recover herself more speedily and more surely than she might otherwise be able to do.

V. Therapeutics.

As in the stomach, the rational treatment of disorder of the duodenum is either *preventive* or *immediate*. Duodenal dyspepsia may be prevented from returning in persons predisposed to it by careful regulation of the quality, quantity, and preparation of the food. The patient must be ordered to eat sparingly of fatty, sweet, and starchy foods, and to avoid richly-cooked

dishes, which generally contain fats in various stages of chemical decomposition. In extreme cases it may be necessary to ensure the digestion of a mixture of the proximate principles of a healthy diet, such as milk and bread or gruel, by peptonising them with an extract of pancreas before they are eaten. Malt extract, which supplies sugar in a form ready for absorption and incapable of fermentation, will be suitable in some cases, but attention must be paid to the time of its administration with relation to meals. Next to the food, the therapeutist will do wisely to attend carefully to the gastric functions, remembering that it is in this way that he will most rationally restore the chemical and physiological balance in the upper part of the intestine. He may elect to give an alkali shortly before meals to secure this end, or he may prefer to administer acids after meals according to the directions already given under the head of gastric digestion. In the former instance he increases the acidity of the chyme physiologically; in the latter instance by simple chemical means.

2. The *immediate* treatment of an attack of acute duodenal dyspepsia will generally follow, as we have seen, upon the treatment of acute indigestion in the stomach. We have studied the beneficial effects of neutralising the excessive acidity of gastric dyspepsia, by means of an alkali combined with a carminative and stimulant, and it is obvious that this will be continued after the chyme has left the stomach. When treated with a full dose of Bicarbonate of Soda and Sal-volatile, it enters the intestine with an acidity probably below the normal, reduces the higher acidity of the irritant chyme already there, and restores the normal action of the glands. If we are called too late to relieve duodenal indigestion in this way, the most rational course that we can adopt is to clear away the offending contents by purgation. Magnesia or its Carbonate act well in these cases, being immediately antacid, and afterwards laxative. More frequently a simple cholagogue purgative should be administered, such as Calomel, which has the further advantage of not disturbing the stomach by its taste or bulk.

Any pain and excessive muscular movements (colic) which may remain, must be treated by sedative remedies, such as Opium or Bismuth. The treatment of diarrhœa and the use of cholagogues and purgatives in chronic duodenal disorders, must be reserved till the next chapter.

Measures Influencing Digestion in the Duodenum.

Food.	Direct Duodenal Stimulants.	Indirect Duodenal Stimulants.	Hepatic Stimulants.
Pancreatised Foods Olive Oil Almond Oil Cod Liver Oil Malt Extract	Diluted Mineral Acids Ether Mercurials	Sialagogues Stomachics Purgatives	Cholagogues Purgatives

CHAPTER VI.

THE INTESTINE.

We now proceed to the consideration of therapeutical methods founded on a more complex physiological basis, namely, the actions and uses of *purgatives* and *intestinal astringents*.

I. Physiological Relations.

As the chyme passes along the small intestine, the chyle and other soluble constituents are absorbed, and what remains is moved onward into the great intestine, where it forms the bulk of the fæces. Along the whole route, fluid is passing in both directions between the intestinal contents and the blood—from the bowel into the vessels, and from the vessels into the bowel. The consistency of the fæces will, therefore, depend upon the activity of absorption, the activity of excretion, and, manifestly, the rate of transit. The more active the absorption, the less active the secretion, and the slower the rate of transit, so much the firmer will be the fæces; whilst liquidity of the fæces will be the result of imperfect absorption, excessive excretion, or rapid transmission. We are accustomed to speak of the one extreme as constipation, and of the other as diarrhœa.

Absorption from the bowel is carried on by the lacteal and portal systems. The great bulk of the water and salts enter the portal system, by a process of diffusion or osmosis. The activity of this process varies greatly—with the amount of water, salts, and proteids in the bowel, as compared with the blood plasma; with the chemical nature of these salts; with the rate of the circulation through the veins—that is, with the state of the liver; and with the condition of the membranes through which the fluids pass.

Excretion is so active in the small intestine that the fæces

are as liquid at the ileo-cœcal valve as in the duodenum, *i.e.* the effect of absorption as regards water is entirely neutralised. The watery excretions, along with a small quantity of solids and gases, are separated partly by osmosis from the vessels, partly by the glands, the latter furnishing the succus entericus. The activity of the glands is doubtless dependent upon many influences connected with their vessels and nerves, and with the quality of the blood, which are still imperfectly understood.

The *transit* of the contents of bowels is effected by peristalsis. The muscular coat is innervated by the vagus and splanchnics, the former increasing peristalsis, the latter tending to restrain or inhibit it, just as the vagus inhibits the heart. Whilst the intestine is connected by these means with the cord and brain, its movements are chiefly automatic and determined by Auerbach's and Meissner's plexuses. The state of tension of the wall, the internal pressure of fæces and gas, is the ordinary stimulus of this mechanism; but the nerves or muscles, or both, are also stimulated by the bile; and may be either excited or depressed by many substances introduced through the blood, as we shall see under the next head, as well as (inversely) by the amount of blood supplied to them. In defæcation the will comes to the assistance of the automatic intestinal movements, and effects evacuation of the bowels.

General effects of evacuation of the bowels.— The effects of evacuation of the bowels are by no means purely local. On the contrary, the whole system is influenced by this act, to no great extent, it is true, under normal circumstances, but very markedly when it amounts to actual purgation. When the bowels are very freely moved, a certain amount of water is directly or indirectly removed from the circulation. Bile is swept out of the bowel, and the liver indirectly stimulated. Certain solids and gases excreted by the intestinal wall, that is, truly excrementitious substances, are thrown out of the system. The circulation in the abdomen is disturbed: the vessels are relieved from the pressure of the fæces; the blood flows more freely from the arteries through the portal system and liver; whilst the volume of blood in the portal system and liver is temporarily reduced by the watery excretion. The heart and vessels generally are thus in turn relieved; the blood pressure in the systemic arteries falls; the cerebral circulation is especially depressed on account of its position, so that faintness may be the result; the respiratory movements become easier; the activity of the venous circulation is increased; and the temperature falls. Amongst the abdominal vessels, the circulation through the renal artery and vein is increased, and with it the volume of urine secreted, diuresis being more

readily induced after purgation, unless the quantity of water drained off by the bowel have been excessive.

II. Pharmacodynamics.

The means of acting physiologically upon the intestine which are at our command are of a much more artificial kind than any we have yet encountered, and introduce us to a large number of medicinal substances.

1. *Food.* The influence of the food is felt in the bowels, and affords us a ready means of acting upon them. Many kinds of food increase the action of the bowels, notably coarse, indigestible articles of diet, such as the husk of cereals made into "brown bread" and "whole-meal"; green vegetables; oils; fruits, fresh or preserved, which contain abundant salts and sugars; soups, broths, and other preparations of meat; eggs; ale and beer; tea and coffee, when properly prepared; and water taken at bed-time, or in the early morning before breakfast. On the contrary, cold articles of food, milk, spirits, red wines, and tea and coffee made strong and badly, are constipating in their effects. Perfect *digestion* in the mouth, stomach, and duodenum, is one of the most powerful means of preserving or restoring the natural action of the bowels.

We now pass from these natural means of acting upon the bowels, to others of a distinctly medicinal character.

2. *Measures which act upon the intestinal Blood-vessels: Drastics; Astringents; Constringents.*—A number of substances disturb transudation by acting upon the *blood-vessels* in the intestinal walls.

a. Drastics.—These cause the vessels to dilate, and retard the blood current, so that the fluid and part even of the solid constituents of the blood escape into the walls and cavity of the bowel. In other words, they establish an inflammation of the mucosa, somewhat resembling a common "cold" in the nose. The result is similar in the two cases: there is a profuse discharge from the mucous membrane, of the watery part of the blood, with a certain amount of solid elements, constituting a "catarrh," and producing in the case of the bowel a very liquid stool. The drugs which act in this way are obviously powerful or even dangerous, and comprise chiefly Croton Oil, Elaterium, Gamboge, and Colocynth. They constitute a group of purgatives known as **drastics** (*δράω*, I act) or **drastic cathartics.**

b. Intestinal Astringents.—Opposed to these measures we possess certain substances which contract the walls of the intestinal vessels, reduce the quantity of watery exudation, prevent the escape of solid elements, and thus diminish the liquidity of the fæces. Such substances, include Lead, Silver, and the

Diluted Mineral Acid, and constitute the first group of **intestinal astringents,** called *intestinal vascular astringents.*

c. Intestinal Constringents.—The substances thus named possess the property of coagulating or otherwise condensing the gelatiniform and albuminous tissue supporting the small vessels of the mucosa, increasing its compactness, diminishing the freedom of the circulation, and thus reducing the amount of exudation through the vessel walls. **Intestinal Constringents** are a very large group, including Persalts of Iron, Alum, Sulphate of Copper, Oxide of Zinc, Tannin, and the numerous vegetable products which yield it or some of its modifications, such as Catechu, Kino, Krameria, and Cinnamon.

3. *Measures which influence Absorption and Excretion.—a. Saline Purgatives.*—Certain salts possess the property of greatly disturbing the *process of osmosis* in the intestinal wall, such as the Sulphates of Magnesia, Soda, and Potash; Phosphate of Soda; Tartrate, and Acid Tartrate of Potash; and the Tartrate of Soda and Potash. These produce two effects, namely, first, increased flow of water from the intestinal vessels into the cavity of the bowel, and consequently increased liquidity of the stools: and secondly, a flow of the salts, with a certain amount of water, from the cavity of the bowel into the blood-vessels, whence it is partly carried away into the general circulation, and partly again excreted into the bowel by the intestinal glands, once more to be absorbed. The result is an abundant liquid stool; in the case of Acid Tartrate of Potash, or very large doses of the other salts, almost entirely watery. The precise way in which these effects are produced by saline substances is still obscure. They appear to be due in part to the difference in specific gravity between the watery materials in the bowel and the liquor sanguinis, in part to some specific action of the salts upon the structures of the walls through which they pass, depending on their chemical constitution and affecting dialysis. According to some authorities, saline purgatives act in a measure by stimulating peristalsis.

These salts furnish us with a ready means of increasing the liquidity of the motions and the frequency of the stools, and constitute the group called **saline purgatives,** the most powerful of which are called *hydragogue salines.*

Saline Astringents.—A sufficient amount of salts, and (within broad limits) a particular strength of solution, are required to secure an abundant excretion; otherwise their absorption in watery solution is stimulated beyond their excretion, and constipation instead of relaxation is the result. The same effect is liable to be produced by their habitual employment. We do not use this group of measures therapeutically.

4. *Measures which influence the Intestinal Glands.—a.* The secretions of the intestinal glands are moderately *increased* by Mercurial preparations; greatly increased by Croton Oil, Elaterium, Colocynth, Jalap, Scammony, and Podophyllin, which no doubt act also upon the vessels and muscles. Jalap and Scammony require to be dissolved in the bile. We have just seen that the saline purgatives are also glandular stimulants, being no sooner absorbed than they are again excreted. This class of purgatives may be called **cathartics** (*καθαίρω*, I cleanse); such of them as produce very watery motions, **hydragogue cathartics.**

b. Opium, Lead, and Lime directly *diminish* the intestinal secretions and promote constipation. Alkalies, Alkaline Earths and their Carbonates interfere with the acidity of the chyme when given in full doses, and thus indirectly arrest the intestinal secretions; whilst, by conversion into sulphates in the bowel, they may become active purgatives. Thus certain saline substances may not only be purgative in more than one way, but may even be purgative and astringent at the same time; the one effect or the other occurring according to the dose, the patient, and other circumstances which are often obscure.

5. *Measures which influence the Nervo-muscular Structures.*—Many of the materiæ medicæ influence the bowels through the *muscular coat*, the *nerves*, or both. Thus drastics excite intestinal peristalsis and griping even before they have left the stomach, as is seen in Croton Oil. Saline purgatives are believed to have the same effect. It is practically convenient to arrange in a special class those substances which act entirely or chiefly upon the intestinal muscles.

a. Nervo-muscular Stimulants. — These include Rhubarb, Senna, Aloes, Castor Oil, Sulphur, Sugars, Nux Vomica, Rhamnus Frangula, Cascara Sagrada, and Belladonna, and many others. They are best given with carminatives, to prevent the intestinal pain caused by excessive or spasmodic muscular contraction, popularly known as "griping," which they readily induce. Belladonna appears to act in a different way from the others, by removing the inhibition of the splanchnic; and ergot by causing anæmia of the muscles. The stool which follows the action of a muscular stimulant is much less watery than that produced by saline or cathartic purgatives, being chiefly the ordinary contents of the small bowel hurried down, unless the drug be given in large doses. For the same reason the disturbance of the portal circulation, liver, the general circulation, and the system as a whole, is less marked. The nervo-muscular purgatives are commonly known as **simple purgatives**; and the mildest of them, such as Castor Oil and

Sulphur, Figs and the like, are classed by themselves as **aperients** (*aperio*, I open), or **laxatives** (*laxo*, I loose), as inducing a simple opening or relaxation of the bowels.

b. Nervo-muscular Intestinal Sedatives.—The drugs which *arrest* the movements of the bowel, either directly or through the nerves, include Opium, Morphia, and Lead, which diminish peristalsis, and may even completely paralyse the bowel. Substances which form a protective lining on the mucosa, and antacids indirectly produce the same effect, by diminishing the irritation of the contents. Bismuth, Chalk, Lime, and Alkalies act, partly at least, in this way. All are **astringents.**

6. *Cholagogues.*—Following naturally on the last class of purgatives comes a group which act indirectly upon the muscular coat, by increasing the flow of its natural stimulant, the bile. These substances are known as **cholagogues** (χολή, bile, and ἄγω, I cause to flow). As will be explained in the next chapter, they either act directly upon the liver-cells and gall-bladder—**direct cholagogues**; or sweep out of the body what bile is lying in the intestine, and thus indirectly stimulate a fresh secretion—**indirect cholagogues.** Direct cholagogues may be illustrated by Podophyllin, Rhubarb, and Sulphate of Soda; indirect cholagogues are chiefly Mercurials. It will be observed that cholagogues and purgatives have complex associations with each other: most purgatives are probably indirect cholagogues; many purgatives happen to be also direct cholagogues; and all cholagogues exert a certain amount of purgative effect, inasmuch as they increase the flow of the natural intestinal stimulant.

We do not deliberately employ **anticholagogue** measures, for *checking* the flow of bile. Opium possesses this action.

Enemata (ἐνίημι, I inject). Many of the remedies just mentioned may be adminstered by enema, that is, injected into the rectum. (1) Food, such as beef tea, eggs, gruel, and milk, and alcoholic stimulants, constitute **nutrient and stimulant enemata.** (2) Intestinal stimulants may be given as **purgative enemata,** chiefly Castor Oil, Olive Oil, and the officinal Enemata of Aloes and Sulphate of Magnesia. (3) Enema Opii is a most valuable **sedative and astringent** preparation. Solutions of Sulphate of Zinc or Copper, Nitrate of Silver, Alum, and Decoctum Quercûs, are also astringent. Enema Tabaci is now very rarely used as a powerful **depressant enema.** The rectum may be mechanically emptied by **simple enemata,** such as warm water, warm soap and water, and thin gruel, which soften the fæces and stimulate the parts. Besides these

we possess **anthelmintic enemata**, which remove worms, such as the Enema Terebinthinæ, Enema Aloes, and an enema of bitter infusions, or salt and water. Ice-cold water may be injected into the rectum as an **antipyretic enema**, *i.e.* to reduce the temperature, and as a **styptic enema** in hæmorrhage.

III. Pathological Relations.

As far as our present purpose is concerned, the disturbances of the intestine, independently of its digestive function, which has been already discussed, are chiefly two, namely: excessive action, the striking phenomenon of which is *diarrhœa*, and defective action, characterised by *constipation*.

1. *Excessive Intestinal Action.*—Diarrhœa, as we have seen, is generally referable to gastric or duodenal dyspepsia. The ultimate cause is most commonly improper food, including the various irritant substances which may be admitted along with it, such as unwholesome drinks, the organisms of putrefaction, and the poisons of typhoid fever, dysentery, and cholera. Irritant poisons have the same effect. Certain intestinal irritants are generated in the body itself, such as urea, the poison of gout (chiefly uric acid), and the poison of pyæmia. Nervous disturbances may produce diarrhœa, for example, anxiety and fear. Disorders of the general and abdominal circulation are frequently attended by a watery flow or flux from the bowels, as in diseases of the liver and heart, or as the result of chill. Lastly may be mentioned organic disease of the intestines. The student must carefully note that diarrhœa, although of much importance in itself and as a cause of further disorder, is but a symptom, the anatomical condition on which it depends varying greatly.

In connection with excessive activity of the intestines must be taken here certain conditions, such as hernia, peritonitis, and perforation of the bowel, in which any peristaltic movement of the intestine, however slight, must be considered excessive because highly dangerous, and in which paralysis of the intestine for the time being is urgently required.

2. *Deficient Intestinal Action.*—Constipation is even more common than diarrhœa, and is peculiarly apt to appear in a chronic form. Of its causes, we may select as illustrative examples certain kinds of food, already noticed; chronic gastric and duodenal dyspepsia, especially in connection with biliary disorder; sedentary or careless habits; and certain specific substances, such as lime and lead, admitted in the food or otherwise. Habitual constipation is generally due to loss of irritability and vigour of the nervo-muscular structures from very chronicity of the state and neglect of regular defæcation;

to impairment of the general health by sedentary occupations, foul air, etc.; to a variety of obscure causes, commonly referred to as locality, and change of habits; and to certain organic diseases of the bowel. The most severe and obstinate cases of constipation are caused by paralysis of the bowel in disease of the spinal cord and lead-poisoning. Although constipation, like diarrhœa, is but a symptom, and must be treated as such, its unfavourable effects on digestion, sanguification, and the functions generally, are almost endless.

Along with constipation must be considered a class of cases where disease of the digestive organs, liver, heart, lungs, general circulation, brain, blood, or kidneys, demands free evacuation of the bowels, and, it may be, even a hydragogue or cathartic action, chiefly as a means of unloading the circulation or of evacuating excrementitious substances. Frequent reference will be made to this application of purgation under the several organs in the following chapters.

IV. Natural Recovery.

Diarrhœa is a striking instance of the first method of natural recovery—by removal of the cause. By this means not only is the bowel purged of irritant matters, but constipation may be naturally relieved by a spontaneous diarrhœa produced by the irritant effect of the retained fæces. Both diarrhœa and constipation, if left entirely to themselves, may spontaneously cease, and the normal action of the bowels return. Therapeutical assistance is, however, constantly valuable, and frequently essential. Thus the diarrhœa of infants may quickly end in fatal exhaustion, and atony of the gut may be the result of neglected constipation.

V. Therapeutics.

1. *Excessive Intestinal Activity; Treatment of Diarrhœa.*—The treatment of diarrhœa should begin, if possible, with *the removal of its cause.* If this is being accomplished by the bowel itself, we must encourage intestinal activity for a time by such purgatives as Castor Oil, Rhubarb, Calomel, Magnesia, and Senna. The first two drugs are specially valuable, as they also possess an astringent action, which comes into force after the purgation. On the same principle, diarrhœa from hepatic or renal disorder or disease, is rationally treated by non-interference or even by a judicious increase of elimination by the bowel, hepatic and renal stimulants being also combined; that is, by the use of a purgative which is partly cholagogue, followed by a diuretic—a mercurial pill supplemented by a

Seidlitz powder. Again, diarrhœa due to acidity in the duodenum is rationally treated by an alkali or alkaline earth, such as Lime-water, Chalk, and Bicarbonate of Soda—a highly successful method in the intestinal dyspepsia of infants. If the cause cannot be removed, its effects may be physically prevented by coating the surface of the bowel with Bismuth.

To *counteract* the irritant influence, astringent measures must be employed; and the two kinds of astringents in general use for this purpose are the constringents and the nervo-muscular intestinal sedatives. Of the former, Tannic Acid is less often used than its allies, between which there is little to choose, such as Catechu, Kino, and Krameria. With the constringent there is usually combined some preparation of opium as a nervo-muscular sedative, in the form of Dover's Powder, Kino, and Opium, or Compound Opium Powder, which relieve pain, diminish the peristaltic movements, check the secretions, and arrest the cramps or tormina. It will be found desirable in almost every case of diarrhœa demanding immediate arrest, to combine a certain amount of opium, however small, with the other drugs. We are now in a position to understand the use of the intestinal *vascular* astringents: Lead, Silver, and Diluted Sulphuric Acid. These are specially indicated in inflammatory conditions of the bowel, such as accompany ulceration in typhoid fever, dysentery, and tuberculosis. Diluted Sulphuric Acid is given when the effect is intended to be speedy and brief. A small quantity of Opium or Morphia is again a powerful adjuvant; for instance, as the Lead and Opium Pill, Diluted Sulphuric Acid and Laudanum, and Dilute Acetic Acid, Acetate of Lead, and Acetate of Morphia combined. In certain cases these remedies may be administered in an enema, the Enema Opii being particularly valuable. Coto Bark is successful in some cases of persistent tubercular diarrhœa. Nervous diarrhœa may be relieved by Bromide of Potassium. Some forms of chronic diarrhœa, and the flux of uræmia (when it can be safely checked), are best treated with Persalts of Iron.

The food is to be ordered in diarrhœa with a view to prevent irritation, and thus contribute to the cure; and dieting must be regarded as of equal importance with the medicinal treatment. The food must be entirely fluid, as a rule, and will consist chiefly of broths and milk. The former must be carefully prepared, without fat or seasoning, and given cold. The milk must be in a form which will not yield a large indigestible curd—itself a source of intestinal derangement, but given with effervescing alkaline waters, or lime-water, or boiled and mixed with some kind of starch, such as arrowroot or rice. Eggs must be used with caution. Ice is the best means of relieving

thirst, or sips of toast-water; draughts of all kinds must be avoided. Stimulants may be required by the aged, by infants, and in all cases of protracted diarrhœa, brandy and port wine being the most suitable forms.

2. *Deficient Intestinal Action: The Use of Purgatives.*—The treatment of constipation consists chiefly in careful regulation of the diet, which should include fruits, green vegetables, meats, and "whole" brown bread, whilst milk and strong tea are to be avoided. As a rule, however, its chronic "habitual" form calls for active interference.

In the treatment of constipation, the *cause must first be removed* if it can be discovered. The diet, digestion, and liver must be regulated, and sufficient muscular exercise, mental relaxation, and other hygienic provisions ensured.

Habitual constipation being generally referable to *torpidity of the muscular coat*, will be rationally treated by the administration of nervo-muscular stimulants. But these must be preceded by a free evacuation, since the tone of the intestinal wall cannot be restored until over-distension has been removed. For this purpose a more powerful purgative must be given at first, such as Colocynth and Blue Pill, followed by a saline, to thoroughly empty the gut; and this practice will be repeated with advantage every few weeks for a time. A regular course of aperient medicine may then be commenced. There is considerable choice of drugs which increase peristalsis, the best for habitual use being Aloes, Senna, Rhamnus Frangula, and Cascara Sagrada. Nux vomica (strychnia) is often added, in cases where the muscular tone has been lost by protracted over-distension; and Belladonna is a valuable adjuvant of Aloes in particular cases. Rhubarb, which is a popular aperient, is apt to produce further constipation.

Muscular torpidity is also rationally treated with cholagogues, and Rhubarb and Aloes act partly in this way. The saline cholagogues, such as Sulphate of Soda, and the many bitter mineral waters now sold (such as Friedrichshall and Hunyadi Jànos) are highly popular habitual purgatives, but are apt to lose their effect if given for a length of time, and then to increase rather than relieve constipation. In anæmic subjects the Pilula Aloes et Ferri, and in uterine inactivity the Pilula Aloes et Myrrhæ, are specially indicated. Purgative or simple enemata must occasionally be ordered, but the practice must not be continued lest it become habitual. It may be necessary to keep up the action of nervo-muscular intestinal stimulants for an indefinite period; and Senna is the best drug for this purpose, especially in the form of the compound Liquorice Powder.

Severe and protracted constipation, in which the bowels are heavily loaded with fæces, as in lead-poisoning or spinal paralysis, or as the result of indolent and careless habits, may demand a cathartic. The officinal preparations of Colocynth are suitable in such cases, containing as they do Aloes and Scammony, so that if they be followed by a saline draught, the entire length of the bowel will be evacuated. Sometimes even Croton Oil is required, and a large purgative enema may be preferable to repeated purgation by the mouth in weak subjects. This is an absolute rule in the constipation of typhoid fever.

The treatment of constipation constitutes but a small part of the use of purgatives. In a considerable proportion of the cases in which purgation is practised, the indication is to hasten or increase the natural activity of the bowels, in order to obtain some or all of the other effects of considerable evacuation, which we have already studied. The practical question then comes to be what degree of activity of purgation is desirable. The activity of a purgative may be estimated by the rapidity of its effect, by the number of the evacuations, by the amount of water in the stools, and by the degree of constitutional disturbance which it produces; these results, as a rule, varying directly with each other.

When there exists an urgent indication for the *reduction of the general blood pressure*, for instance, in cerebral hæmorrhage, with enlarged heart, the most active purgatives are employed. A drastic must then be given, such as Croton Oil, which has the further advantage of being very easily administered to an unconscious patient. When the portal system, heart, or systemic veins are overloaded, and the fluids of the blood are finding their way out of the vessels so as to constitute dropsy, *hydragogue cathartics and salines* are given, to establish a free flow of water from the bowel, and thus relieve the circulation. Jalap in the form of the Compound Powder, Colocynth, and—most powerful of all—Elaterium, are commonly employed, less frequently Scammony. Frequent saline draughts, either alone or after a purgative pill, have the same effect, such as the Sulphates of Soda and Magnesia, Cream of Tartar, and Rochelle salt.

At the commencement of inflammatory affections, for instance, acute bronchitis or local abscess, it is usual to unload the bowels and relieve the liver, heart, vascular tension, and respiration, by means of a *simple purgative*. The Colocynth and Hyoscyamus pill, with or without Calomel or Blue Pill, is well adapted for these cases, being given at night and followed in the morning by a Seidlitz powder.

Chronic congestion of the pelvic organs, bowels, and liver, a form of disorder not uncommon with sedentary persons, espe-

cially women, may call for a course of treatment by *aperient mineral waters*, usually containing Sulphates of Soda and Magnesia, at some watering place, or systematically at home.

Contra-indications and abuses of purgatives. — Purgatives must be used with special caution in delicate subjects, such as infants and the aged; in persons weakened by disease; in inflamed ulcerated conditions of the bowels; when there is a tendency to hæmorrhoids and other affections of the rectum; in pregnancy, and during menstruation. In such subjects and conditions, constipation should be relieved if possible by enemata or mild aperients, such as Castor Oil, Sulphur, Senna, and dietetic laxatives. Aged persons do not bear saline purgatives well unless they be given warm or combined with a carminative. The evil effects of the habitual use of purgatives has been already referred to.

Anthelmintics.—In connection with the remedies directed to the intestine, must be discussed the *anthelmintics* (*ανrι*, against, and *ἕλμινς*, a worm), or medicines which expel or kill worms. These belong to two classes, namely (1) **vermifuges**, which simply expel the parasites (*vermis*, a worm, and *fugo*, I drive out); and (2) **vermicides**, which destroy them (*vermis*, a worm, and *cædo*, I kill). The vermifuges belong to the cathartic purgatives, such as Scammony and Jalap: they may be given either alone, combined with, or several hours after a dose of a vermicide. The principal vermicides are Male-Fern, Turpentine, Kamala, Kusso, Pomegranate Root, and Areca, Santonica and Santonin. The last named drugs act specially on the lumbicus, the others kill the tape-worm. The thread-worm (oxyuris) which infests the rectum is best reached by anthelmintic enemata of Turpentine, Aloes, or Salt and water, preceded by injections of a bitter infusion, such as Calumba or Quassia, with or without iron, to remove the mucus in which they flourish.

Anthelmintics.

Vermifuges.	Vermicides.	Indirect Anthelmintics.
Jalapa	Filix Mas	Quassia
Scammonium	Santoninum	Calumba
Cambogia	Ol. Terebinthinæ	Persalts of Iron
	Kusso	Sodii Chloridum
	Spigelia	
	Kamala	
	Areca	
	Granati Radix	

SYNOPSIS OF SUBSTANCES WHICH ACT UPON THE INTESTINES.

DRASTICS.

Action.—*Chiefly cause catarrh of mucous membrane; increase glandular secretions and peristalsis.*

- Elaterium
- Croton oil
- Colocynth in excessive doses
- Gamboge
- Guaiacum

SALINE PURGATIVES AND HYDRAGOGUE SALINES.

Action. — *Chiefly disturb osmosis; also stimulate the glands and increase peristalsis.*

- Potassæ Tartras Acida
- Potassæ Tartras
- Potassæ Sulphas
- Sodæ Sulphas
- Soda Tartarata
- Sodæ Citro-tartras Effervescens
- Sodæ Phosphas
- Sodii Chloridum
- Magnesiæ Sulphas

CATHARTICS AND HYDRAGOGUE CATHARTICS.

Action. — *Chiefly increase glandular secretion, increase peristalsis, cause catarrh of mucous membrane.*

- Mercurials
- Jalapa
- Scammonium
- Podophyllum
- Rhamnus
- Turpentine
- Tobacco
- Elaterium
- Colocynth

SIMPLE PURGATIVES.

Action.—*Increase peristalsis actively.*

- Rheum
- Senna
- Aloes
- Small doses of drastics, cathartics, or salines.
- Fel Bovinum.

LAXATIVES OR APERIENTS.

Action.—*Increase peristalsis moderately.*

- Oleum Ricini
- Senna
- Sulphur
- Manna
- Ficus
- Tamarindus
- Rhamnus Frangula
- Cascara Sagrada
- Rhamnus Catharticus
- Cassia
- Magnesia
- Magnesia Levis
- Magnesiæ Carbonas
- Magnesiæ Carbonas Levis
- Physostigma
- Ergota
- Belladonna
- Stramonium
- Hyoscyamus
- Sapo
- Taraxacum
- Ipecacuanha
- Mel
- Glycerinum
- Morus
- Oleum Olivæ
- Oleum Amygdalæ

SYNOPSIS OF SUBSTANCES WHICH ACT UPON THE INTESTINES (*continued*).

DIRECT CHOLAGOGUES.

Action.—*Stimulate liver.*

Ammoniæ Phosphas
Sodæ Phosphas
Soda Tartarata
Sodæ Sulphas
Acidum Nitrohydrochloric. Dilutum
Podophyllum
Ipecacuanha
Rheum
Jalapa
Scammonium
Colchicum
Colocynthis
Aloes
Acidum Benzoicum
Euonymin
Iridin
Sodæ Salicylas
Hydrargyri Perchloridum

INDIRECT OR MERCURIAL CHOLAGOGUES.

Action.—*Empty biliary passages, stimulate intestinal glands, and stimulate liver* (?)

Mercurials
Cathartic Purgatives

INTESTINAL GLANDULAR DEPRESSANTS.

Opium
(?) Belladonna
Plumbi Acetas
Calx
Creta
Alkalies indirectly through chyme
Alkaline Earths indirectly through chyme

INTESTINAL VASCULAR ASTRINGENTS.

Plumbi Acetas
Argenti Nitras
Acid. Sulphuric. Dilut.
Acid. Nitric. Dilut.
Acid. Acetic Dilut.
Acid. Phosphoric. Dilut.

INTESTINAL CONSTRINGENTS.

Tannic Acid and all vegetable substances containing it
Alum
Persalts of Iron
Zinci Oxidum
Cupri Sulphas

NERVO-MUSCULAR SEDATIVES.

Opium
Belladonna
Hyoscyamus in last stage
Plumbi Acetas
Calx
Creta
Bismuthum; and Alkalies indirectly through chyme

ANTI-CHOLAGOGUES.

Opium
Plumbi Acetas
Intestinal irritants

ADJUVANTS OR CORRECTIVES.

Antimonium
Piper
Valeriana
Nux Vomica
Capsicum
Hyoscyamus
Belladonna
Stramonium
Cardamomum
Zingiber
Cannabis Indica
Caryophyllum, Cajuput, and other Aromatics

CHAPTER VII.

THE LIVER.

I. Physiological Relations.

The substances which enter the liver through the portal vein consist of the products of digestion in the widest sense, namely, proteids including leucin and tyrosin, sugars, salts, a trace of fat, and abundant water. When we parted with the proteids in the duodenum, they were in the form of peptones; when we meet with them again in the vena portæ, they have been transformed into ordinary serum albumen, apparently in the process of absorption. The sugars enter the liver partly unchanged, partly perhaps as derivatives—lactic and butyric acid. The proteids, sugars, water, salt, etc., will obviously be poured into the liver very abundantly during digestion. At the same time, there enters the liver through the hepatic artery a supply of oxygen which appears to be precariously limited, if we may judge by the size of the vessel. In the presence of this double supply, and in proportion to it, the hepatic cells display their special activity, and yield glycogen, urea, and bile. The urea and bile are carried off as such, the former by the hepatic veins to escape by the kidneys, the latter by the bowels. The glycogen has a less simple history. It accumulates in the liver cells, where it appears as a form of amyloid material specially adapted for storing up in an insoluble state the sugar and part of the proteids. By this arrangement the blood and body generally are saved from being flushed with sugar after each meal, and the sugar itself is not wasted. Under the influence of a ferment the glycogen is gradually re-converted into some kind of sugar; the amount of amyloid material hydrated varying with the necessities of the system. This function is regulated by a nervous mechanism, having its centre in the medulla, with efferent and (presumably) afferent nerves.

Another point in connection with the liver to be carefully noted by the therapeutist is *the circulation of the bile.* The bile, having entered the bowel and mixed with the chyme, is not entirely evacuated by the fæces. On the contrary, its most important constituents, the biliary salts, are re-absorbed from the bowel and carried back to the liver, again to be secreted and reach the bowel. Thus the bile may be said to move in a circle, comprised by the bile ducts and gall bladder, the intestine, and the portal vein.

II. Pharmacodynamics.

Although the liver is apparently so inaccessible, we have great control over the influences under which its multiform activity is displayed.

(1) By means of the *food* we can completely interrupt the hepatic functions, or interfere with them at our pleasure. The amount of urea, the secretion of bile, the proportion of store glycogen in the liver, may be modified directly, within certain limits, by the amount of food allowed; and the urea and glycogen may be respectively made to vary with the relative proportion of nitrogenous and amylaceous constituents in the diet. The supply of oxygen which reaches the liver by means of bodily exercise, is equally under our control. The larger the volume of oxygen entering the liver, the more ready and complete will be the subtle processes of chemical composition and decomposition within it. We thus come to appreciate a fact of the first importance—that we can influence the liver through the medium of its *supply*. But we can do so in another way. We can tap, as it were, the channel of supply, the portal vein. The radicals of the portal vein in the rectum (superior hæmorrhoidal) anastomose with the veins around the anus, and leeches applied to this part will drain blood from the portal system, and thus indirectly from the liver. Closely allied to bleeding in principle is hydragogue purgation, which diverts a quantity of water from the portal radicles in the intestinal wall, and secures its evacuation.

(2) The liver may be influenced through its *products*, by securing the proper disposal of the urea, bile, and glycogen. In the bodily organs, as in the practical arts, the rate of manufacture cannot be maintained unless the products be removed. We have seen, in the stomach, that digestion is arrested by accumulation of peptones amongst the food. In the like manner, an accumulation of urea, of bile, or of glycogen, in the system, interferes with the hepatic processes. Now, as we shall afterwards see, we can increase the elimination of urea by the kidney, and thus indirectly stimulate the liver. On the same principle, the disposal of the bile furnishes us with a means of rousing the hepatic functions. This brings us to consider the action of indirect cholagogues.

That portion of the circulation of the bile which occurs in the intestine is thoroughly under our control. We can sweep the bowels empty of its contents; and with these the bile, which otherwise would have been re-absorbed, is expelled from the body. The portal blood and liver are thus deprived of material in which the biliary salts exist ready made, namely,

their own products; and the hepatic cells are driven to fresh secretion. The purgatives which sweep away the old bile, and so lead to the production of new bile, are called **indirect cholagogues.** Mercurials specially act upon the liver in this way.

(3) We believe that we can modify the metabolic processes in the liver by **specific hepatic stimulants and depressants,** irrespective of both the supply and the products. Thus, Phosphorus, Antimony, and Arsenic, increase the metabolic activity of the liver, causing a greater production of urea, and the last two a free flow of bile. Bicarbonate of Soda and Dilute Nitrohydrochloric Acid have probably the same effect as regards the glycogen and the bile. Chloride of Ammonium remarkably increases the amount of urea, apparently by its own decomposition, but still probably through the agency of the liver cells. Iron increases the amount of urea. Amyl Nitrite stimulates the glycogenic function. On the other hand, there can be no question that the whole process of hepatic activity may be remarkably reduced by means of Opium, and to a less degree by Quinia and Alcohol.

The direct effect of certain drugs upon the secretion of bile is unquestionable. Podophyllin, Rhubarb, Aloes, Colocynth, Colchicum, Jalap, Scammony, Ipecacuanha, Sulphate of Soda, Phosphate of Soda, and Chloride of Ammonium, Nitrohydrochloric Acid, and (non-officinal) Euonymin and Iridin, stimulate the liver substance and increase the amount of bile secreted, and are therefore **direct cholagogues.** Mercurials, including Calomel, as well as acids and such substances as **Guaiacum, Sarsaparilla,** etc., possibly act less powerfully as direct hepatic stimulants. Opium and Morphia reduce the activity of the secretion.

III. Pathological Relations.

The therapeutics of the liver will be best illustrated by a study of the treatment of its functional disorders. The common causes of derangement of the liver are to be found in the materials supplied to it, namely, food and air, and especially in the want of due proportion between the two. Most frequently there is excess of food—excess of rich food, especially of meat and alcoholic drinks, causing also primary indigestion. On the other hand, there may be imperfect oxygenation of the blood supplied through the hepatic artery, *i.e.* deficient respiration and circulation, generally referable to sedentary or luxurious habits, abstinence from muscular exercise, and confinement to ill-ventilated hot atmospheres. Not uncommonly the two classes

of causes are combined, as is well seen in the disorders and diseases of the liver so common in the tropics.

Another way in which disorders of the liver originate is through retention of the products. If the kidneys, lungs, or bowels are inactive, the liver will be blocked, as it were, by urea, uric acid, sugar, and bile; and hepatic metabolism will become feeble. This condition is generally referable to impaired muscular and circulatory activity; to want of exercise, air and light, which beget renal and intestinal torpidity: it is the disorder of town life. In other cases debility of the liver is distinctly inherited.

In whatever way induced, derangement of the liver consists in certain disturbances of the chemical processes within it, which manifest themselves by altered composition of the excretions and many well-marked symptoms. The urine contains an excess (rarely a deficiency) of urea, an excess of uric acid, occasionally sugar, and even albuminous bodies, derived probably from the liver; whilst its reaction is disturbed, the colouring matter is in excess, and leucin and tyrosin make their appearance in it. The bile is altered in quantity and quality, giving rise to diarrhœa or constipation with foul pale stools, to inspissation of bile in the ducts and gall bladder, and the formation of gall stones. The general symptoms of biliary disorder are referable to the circulation in the blood of an excessive amount of the normal products—urea, uric acid, etc., and of imperfectly formed products allied to these. Such products of disordered metabolism, though differing from the normal only by a few atoms, or in the arrangement of their atoms, may be highly deleterious in their action on the body. Entering the blood by the hepatic veins, they disturb the nervous system, and are the cause of the sleepiness, languor, irritability of temper, the headache, and the general misery and melancholy, so familiar in the "bilious." They enter the muscles and produce aching, weariness, muscular debility, and trembling. Palpitation and flushing indicate their action on the circulation, whilst the general nutrition also suffers. If this condition persist, certain chronic states of the system are induced, which are known as gout and lithæmia. The heart and vessels become diseased, as well as the skin and joints. Continued disturbance of the reaction and constitution of the urine leads to a deposit in the urinary passages of some of its salts in a solid form, constituting gravel or calculus; and structural disease of the kidneys may ultimately result.

Absorption of bile into the blood may occur in these cases, but more so in actual plugging of the ducts, which leads to *jaundice*. In either case, some or all of the constituents of the

bile enter the blood, circulate with it, colour all the organs, and are cast out in the various secretions, especially the urine.

Lastly, the glycogenic function of the liver may be disordered, and sugar make its appearance in the blood, urine, and all the tissues, constituting glycosuria or diabetes mellitus. Excess of sugar-yielding food may cause this, as we have seen, but well-marked diabetes is generally referable to derangement of the elaborate nervous and chemical processes of storing and re-distributing the nutrient elements of the food carried on in the liver. Hunger and wasting are therefore its prominent symptoms, and thirst is also very urgent from the diuretic effect of the sugar. In some instances diabetes may be traced to injury or disease of the hepatic ("diabetic") centre in the brain, or of the nervous connections between it and the liver.

IV. Natural Recovery.

Disorder of the liver disappears under favourable circumstances; that is, with a return to the normal influences. Recovery is assisted, on the one hand, by temporary abstinence from food, brought about by loss of appetite, or even loathing for food; and, on the other hand, by excretion of the morbid products. Excess of bile relieves itself naturally by bilious diarrhœa. Nature requires guidance, however, in hepatic disorders, for the languor, depression, and muscular debility which it originates tend to give rise to further indisposition to exercise, and thus to an aggravation of the evil.

V. Therapeutics.

Hepatic disorder can only be *prevented* by taking a comprehensive view of the relation of the liver to the organs of digestion, absorption, blood-formation, and excretion. The income in the way of food and air must be thoroughly supervised. The diet must be definitely ordered. Perfect digestion and intestinal activity must be secured. In many cases it is found that when this has been done, little more is required. Abundant bodily exercise must be recommended. The atmosphere breathed must be as pure, cool, and bright as possible. Sedentary or lazy habits must be changed for wholesome exercise in the open air, in the form of walking or riding. In the class of cases of disordered liver constantly met with in large towns, change is essential from the foul hot dull atmosphere of the workshop and dwelling, to the pure air of the parks or of the country. But the beneficial effect of exercise on the liver is not to be estimated solely by the amount of oxygen admitted. It will also be evident in increased activity of the kidneys,

skin, and bowels, all of which will unburden the liver by hastening the removal from the blood of metabolic products.

If prophylaxis fail, and disorder be actually present, *immediate treatment* must be undertaken. The first step will be to remove, if possible, the causes of the disorder. A careful inquiry into the habits and constitution will often reveal serious errors in the mode of living. These must be reformed as has just been suggested. Active medicinal treatment must be begun at the same time; and in arranging the details of this, several objects may be combined. A brisk purge must first be employed, so as to sweep the intestine of imperfectly digested food, and stimulate its absorptive, excretory, and locomotive functions. The question of the selection of a purgative introduces us to the use of cholagogues. Calomel and Colocynth, Rhubarb and Colocynth, Podophyllin, and a variety of allied purgatives and cholagogues, mentioned in the second section, in proper combination with carminatives, are in constant employment for increasing the flow of bile. An almost invariable practice is to follow up the purgative by a saline, and the rationale of this plan is obvious. The Sulphate of Magnesia, Sulphate of Soda, or Tartrate of Potash and Soda with Tartrate of Soda (Seidlitz powder), not only complete the evacuation and stimulation of the bowel and the cholagogue effect, but their hydragogue influence (with that of the previous purgative), will drain a certain amount of water from the portal vein, and thus relieve the circulation within the liver. At the same time some of the salts will be absorbed into the blood and excreted by the kidney, which, as we shall afterwards see, they powerfully stimulate, thus opening the second great channel of relief to the liver—the urinary discharge. The tartrates pass out in the urine as alkaline carbonates, and by this means the excess of uric acid which may have threatened or had actually produced gravel, is neutralised and safely conducted from the body. Altogether the time-honoured Blue Pill and Seidlitz powder are a combination which is in every respect scientifically sound, although probably of purely empirical origin. In urgent cases of acute hepatic disorder, the therapeutist may even divert part of the blood-supply by tapping the portal vein, that is, by applying leeches round the anus.

An attempt may next be made to act upon the liver *directly:* to rouse its metabolic energy by one of the specific agents already enumerated. Perhaps the best of these in acute hepatic disorder is Bicarbonate of Soda, given between meals in some of the combinations suggested in chapter iii., especially with Rhubarb, Senna, or Aloes. In more chronic cases, Chloride of Ammonium or Arsenic often proves of great

service given immediately after meals, or that valuable combination of hepatic stimulants, the Pilula Hydrargyri Subchloridi Composita, given every night for a week on end. In cases of chronic hepatic disorder originating in the tropics, Diluted Nitrohydrochloric Acid is often used with success both internally and as a bath. The effects of hepatic disorder upon other parts of the system frequently demand direct relief, such as the headache, languor, or mental depression. Alcohol will frequently answer the purpose, but induces further hepatic disorders, and is otherwise obviously objectionable. The same remarks apply to Opium, except in very small doses "to take the edge off the misery." Quinia given after meals is of unquestionable service in many instances. Tea and coffee are useful and safe remedies. But on the whole too much reliance must not be placed on treating symptoms.

For the treatment of that remarkable disorder of hepatic metabolism which is called diabetes mellitus, the complete rearrangement of the diet is the first requisite, by the removal of amyloid and saccharine substances from the food. Nothing in the whole range of therapeutics is more striking in its way than the effect of Opium, Morphia, or Codeia in dispelling the last trace of sugar from the urine in such cases, the quantity of the drug tolerated being sometimes enormous.

Substances which act upon the Liver.

Direct Cholagogues.	Direct Cholagogues. — (*Cont.*)	Glycogenic Stimulants.	Substances Increasing Urea.
Antimonium Sulphuratum	Rheum		Antimonium
Acidum Arseniosum Dilutum	Acidum Benzoicum	Amyl Nitris	Phosphorus
Acidum Nitricum		Sodæ Bicarbonas	Acidum Arseniosum
Acidum Nitrohydro. Dil.	Indirect Cholagogues.	Acidum Nitrohydrochloricum Dilutum	Ammonii Chloridum
Hydrarg Perchlor			Ferrum
Soda Salts	Hydrargyrum		
Ipecacuanha	Cathartic Purgatives		
Colocynthis		Glycogenic Depressants.	
Podophyllum			Substances Diminishing Urea.
Sodæ Salicylus	Antichologogues.		
Ammoniæ Phosphas			
Euonymin		Acidum Arsenicosum	
Iridin	Opium	Opium	Opium
Aloes	Morphia	Morphia	Morphia
Colchicum	Plumbi Acetas	Codeia	Colchicum
Jalapa	Intestinal Irritants		Alcohol
Scammonium.			Quinia

CHAPTER VIII.

THE BLOOD.

We will now suppose that the products of absorption and hepatic metabolism have entered the blood. The peculiar relations which the blood bears to the solid organs gives a special character to its pathology and therapeutics. It possesses of itself no active functions, but is simply a great fluid medium which conveys nutrient material and oxygen to the tissues, and carries away the products of their activity. In the same way it is the medium by which the active principles of drugs reach the internal organs, without, as a rule, materially disturbing the functions of the blood itself. It is not surprising that the blood should have comparatively few primary disorders, whilst it is constantly liable to suffer in consequence of disease of the digestive organs from which we have traced its supply, and of the excreting organs by which its constituents finally leave the body.

I. Physiological Relations.

The physiological relations of the *liquor sanguinis* are very obvious: it is the medium of nutrition. It carries between the different organs the materials which are the sources of energy, namely albumins, fats, sugar, water, and salts, as well as the products of the vital processes—carbonic acid, water, urea, salts, and other substances. It possesses a mean volume, an alkaline reaction depending on the presence chiefly of salts of soda, and a certain general uniformity of composition, which, however, varies considerably at different parts of the circulation—for instance, before and after exposure of the blood to the liver, lungs, muscles, or other active organs. The composition of the liquor sanguinis is indeed the balance of two opposed processes—a process of supply, income, or ingestion, which we have traced through the liver from the food; and a process of production, expenditure, or egestion, carried on by the active organs of the body, with their measurable products, energy and excretions. The *white corpuscles* are physiologically associated with the plasma, that is, are essentially nutritive, in function; but are probably also the source of the red corpuscles.

The function of the *red corpuscles* is perfectly distinct from the functions of the plasma. They are the great medium of respiration, carrying oxygen from the lungs to the tissues, and are thus the respiratory elements of the body. It is important

for the therapeutist to remember that the red corpuscles consist chiefly of *hæmoglobin*, with a small quantity of salts, which have *potassium* as their principal base united with *phosphoric acid*. Iron is an essential component of hæmoglobin ($C_{600}H_{960}N_{154}FeS_3O_{179}$). Whatever may be the immediate source of the red corpuscles, there can be no doubt that the most important factors in their development are food, air, and free exposure of the blood to light. Ultimately they are broken up, their products forming the colouring matters of the various secretions.

II. Pharmacodynamics.

1. Our power over the blood plasma in health is easily appreciated. The most obvious means of influencing it is through the *income* or supply. We can alter a man's diet, his digestion, and his hepatic functions, and by these indirect means we retain a hold on the vital fluid. We can also modify its several constituents during their ingestion—the albumen, sugar, water, phosphates, carbonates, chlorides, sulphates, etc.—by regulating the food or administering them in the form of drugs. A fact of great therapeutical importance is that we can *increase, within certain limits, the alkalinity* of the plasma by means of alkalies or alkaline earths, given as the Bicarbonates of Potash or Soda, as the various solutions of these or of Lithia, Lime, and Magnesia; or in a more moderate degree over a longer period, by means of the many natural alkaline waters, such as those of Vichy, Carlsbad, Baden Baden, Ems, and Bilin. **Alkalinisers of the blood** act upon the plasma not only directly, but indirectly by combining with uric acid, and carrying it with them out of the system by virtue of their diuretic influence. Potash is the most rapid and evanescent alkaliniser; Soda is slower and more permanent, as is fully described in Part I. The citrates and tartrates are also alkalinisers of the blood, being decomposed, as we shall presently see, in the presence of the red corpuscles, into alkaline carbonates. It is much more difficult to *reduce the natural alkalinity* of the blood. Mineral Acids have very little effect in this direction, as they enter the blood in the form of neutral salts of potash, soda, etc., which pass out undecomposed. Citric and Tartaric Acids remain partly unchanged in the plasma, and Benzoic, Cinnamic, and Salicylic Acids also pass through it, the two first being partly converted into hippuric acid. Free Iodine may be temporarily liberated in the plasma from the iodides.

Besides these, most of the materiæ medicæ enter the system through the plasma, where they exist in every possible form, whether unchanged, or as albuminates, chlorides, sulphates,

etc., or as highly complex compounds. It is most important, however, for the student to observe that, beyond the alkalies and acids, but few drugs act upon the plasma. The great majority of them simply exist in it, and are conveyed by it to the tissues and organs of elimination, where they exert their specific influence.

But we may go beyond this, and alter the total amount of blood or plasma in the body by actually adding to it from the blood of another person or animal. This is done by *transfusion*, a powerful means of restoring the blood, but one which is not always readily available.

2. We can affect the value of the plasma through the *expenditure* or egesta. We have seen that purgation is a ready means of influencing the water, salts, albumen, and other constituents of the plasma in the portal system, and thus in the blood generally. We shall find in subsequent chapters that in the same way we can stimulate excretion by the kidneys and by the skin. We shall also discover, under the head of metabolism, that we can so far either tax or spare the great organs which are the source of vital energy and therefore of waste, such as the muscles, and thus the metabolic and nutritive value of the whole blood. But we can go much farther than this: we can actually *abstract* a certain quantity of blood by venesection, cupping, or leeching, as we have already seen in the case of the portal vein; and such alteration in quantity will cause a decided alteration in quality, for, as we shall find in chapter x., abstraction of blood increases the amount of water in the plasma.

3. A small number of drugs are known to act directly upon the *white corpuscles*. Quinia reduces their number, and paralyses their movements; Veratria kills them (out of the body). All aromatic oils, resins, and gum-resins, especially Myrrh, are believed to increase their production.

4. We can increase the richness of the blood in *red corpuscles*, and the richness of the individual corpuscles in hæmoglobin, by giving abundant digestible and assimilable food, and by securing the activity of the lacteal tract, which is concerned in their production. Fresh air and sunlight can be secured by change of habits or residence. We can also increase the constituents of the red corpuscles admitted into the system. Iron, which the pharmacopœia provides in so many forms, directly increases the amount of hæmoglobin even in healthy individuals. Carbonate of Potash, in proper combination with Iron, as in the Mistura Ferri Composia or Blaud's pill, unquestionably increases its value. Phosphoric Acid, whether as the Diluted Acid or as the Phosphate of Iron and other bases, is also a reputed blood-restorer. All

these substances, and such others as indirectly improve the quantity and quality of the hæmoglobin, are known as **hæmatinics.**

Arsenic, Phosphorus, and perhaps other metals combine with the hæmoglobin, partially reduce it, or otherwise interfere with its constitution or quantity, so as to impair the oxygenating power of the corpuscles if given in full doses. Citrates and Tartrates have a peculiar deoxidising effect on the blood, being converted in part into carbonates at the expense of the hæmoglobin, thus, $2K_3C_6H_5O_7 + O_{18}$ (from hæmoglobin) $= 3K_2CO_3 + 9CO_2 + 5H_2O$. Lead reduces the number of the red corpuscles, but probably indirectly, by interfering with digestion. Iodine and Sulphur (Sulphides), Turpentine, and a few other drugs, such as Diluted Hydrocyanic Acid, reduce the oxy-hæmoglobin of the corpuscles, but only after excessive doses, so that in this respect they may be regarded not as drugs, but as poisons, and will be noticed in the next section. The Nitrites of Amyl and Soda, and Spiritus Ætheris Nitrosi convert part of the hæmoglobin into met-hæmoglobin, but only when given in excess. On the other hand, Alcohol and Quinia bind the oxygen more firmly to the corpuscles, and thus reduce oxygenation. Nitrous Oxide gas acts indirectly on the corpuscles by taking the place of oxygen, but does not chemically combine with the hæmoglobin. It is manifest that the methods of venesection and transfusion will influence the corpuscles as well as the plasma.

III. Pathological Relations.

As was mentioned in the introduction, the morbid conditions of the *plasma* are chiefly secondary; that is, caused by disorder either of the organs from which it draws its supply —the digestive organs and liver, or of those by which its products leave the body, especially the lungs and kidneys.

Thus excess of blood, which constitutes one kind of plethora, is referable to indulgence in food, combined with lazy habits. The opposite condition, anæmia, or deficiency of blood, is a very common disorder, which may arise from an endless variety of causes, whether of the nature of want (insufficient food or imperfect digestion) or of waste (excessive work, growth, exhausting diseases, or hæmorrhage). The constituents of the plasma are no doubt often disordered, but this subject is still obscure. The albumins are deficient in anæmia. Carbonic acid increases in respiratory difficulty. The water of the blood is increased in anæmia; greatly diminished in cholera, where its excretion is excessive. The alkalinity of the plasma is believed to be reduced in rheumatism, from some unknown

cause. Uric acid is certainly in excess in gout. In calculous subjects there is apparently some obscure tendency to disturbance of the reaction of the blood, referable to derangement of primary and secondary digestion. Sugar is in excess in diabetes, probably from disordered supply; urea is in excess in Bright's disease, from defective excretion. The *white corpuscles* are liable to abnormal increase, as in leukæmia, but it is still doubtful whether these are instances of primary disease of the blood.

The diseases of the *red corpuscles* are certainly few and imperfectly known; practically they may be represented as deficiency, and deoxydation or reduction of hæmoglobin. *Deficiency* of hæmoglobin, whether traceable to want of blood as a whole, to poverty of the blood in *red corpuscles*, or to deficiency of the individual corpuscles in hæmoglobin, reduces the oxygenating value of the vital fluid. All the bodily functions become feeble: the patient is weak, dull, sleepy, and suffers from every possible functional derangement, especially shortness of breath.

Reduction of hæmoglobin, or, more correctly, of oxyhæmoglobin, is a result of the admission to the blood, in poisonous quantities, of certain substances which we have already mentioned, such as Phosphorus, Arsenic, or Turpentine in poisonous doses. Carbonic Oxide enters into combination with the hæmoglobin, whilst the oxygen is expelled from the corpuscles. Hydrocyanic Acid unites partly with oxyhæmoglobin, partly with reduced hæmoglobin. Other bodies, such as Sulphuretted Hydrogen, seize upon and combine with the oxygen, leaving the reduced hæmoglobin to be dissolved out of the corpuscles and diffused through the blood. Either of these conditions is highly dangerous, the new hæmoglobin compound in the first case being with difficulty replaced by oxyhæmoglobin; whilst the reduction and solution in the second case are incompatible with life if they have occurred to any extent.

IV. Natural Recovery.

The quantity and functional value of the liquor sanguinis, being but the balance between the income and output of the body, readily return to the normal after disturbance. The same is true of the corpuscles. As long as the disorders of the red corpuscles are of a purely quantitative kind, the restoration of the normal conditions is followed by a return of the blood-elements to their proper constitution. The natural means of recovery are to be found in the shortness of breath and debility which accompanies anæmia, and which compel the patient to spare the blood every possible source of waste; at the same time the increased

frequency of the pulse and breathing compensate for want of hæmoglobin. Unfortunately there is here as elsewhere a limit to recovery, as when large quantities of a poison, such as carbonic acid, have entered the blood, or when the hæmoglobin has been reduced.

V. Therapeutics.

The facts which we have reviewed under the four preceding heads are highly encouraging to the practical therapeutist.

In *plethora* he will reduce the amount of food, increase the excretions, and prescribe increased bodily exertion; five-and-forty years ago he would have bled the patient freely, and repeated the operation at regular intervals.

Anæmia must be treated by the opposite class of measures, which will be discussed immediately under the head of the red corpuscles. Speaking generally, we must sustain and restore the appetite and digestion, spare the body every possible exertion, maintain healthy excretion, and, if the condition be urgent, even transfuse blood into the veins. Deficiency of albumen is met by the same measures. Excess of carbonic acid demands artificial respiration, as we shall find under respiratory diseases.

When the indication is to *increase the alkalinity* of the plasma in rheumatism, gout, and allied morbid states, we administer salts of Potash, Soda, Ammonia, Lithia, or the Alkaline Earths, the Alkaline Citrates and Tartrates being the most suitable because large quantities can be admitted into the blood without deranging digestion. Acids, which have so little influence in the opposite direction, are fortunately seldom called for. The treatment of poisons in the blood, whether formed in the body or introduced from without, will rationally consist first in removing their cause, *e.g.* indigestion or renal disorder, or in decomposing or neutralising them chemically. This introduces us to the second use of alkalies in the blood. The acid of rheumatism, whatever it may be, and the uric acid of gout, are converted into soluble salts by the Alkalies and Alkaline Earths, and these salts are fortunately diuretic. In this way excess of acid is not only neutralised, but conveyed out of the system, and the reaction of the urine may be used as a test of the success of our action on the blood. This end is secured in acute cases by the free exhibition of the milder salts of Potash, Soda, Ammonia, and Lithia; in chronic cases by treatment at an alkaline bath, such as Ems, Homburg, Vichy, Carlsbad, Buxton, or Bath. Metallic poisons, such as lead, are removed from the blood and tissues in precisely the same way; lead, for example, by Iodide of Potassium or Sulphur baths.

Poisons may also be removed from the blood by simple increase of the excretions—carbonic acid through the lungs by artificial respiration; urea by diuresis, free purgation, and diaphoresis; and so with the products of indigestion, which is relieved by a cathartic pill and a saline draught.

If the *hæmoglobin be deficient*, we must secure a sufficient supply of digestible and nutritious food, pure air, and direct sunlight; reduce the amount of work, by ordering rest or even confining the patient to bed; and attend to all the functions which are connected with the formation, growth, and purification of the blood. Correction of derangements of the stomach and bowels always demands special attention, and is a *sine qud non* for success. At the same time, any actual waste of the blood must be arrested, if possible. Passive hæmorrhages must be checked. Growth and development may be rendered less trying by directing the blood to parts where it is specially required; for instance, to the uterus by means of emmenagogues. We must next hasten to restore the red corpuscles by supplying their important chemical elements—Iron, Phosphoric Acid, and Potash. Long before the composition of hæmoglobin was understood, it had been empirically discovered that Iron was a certain remedy for "want of blood." This is our daily experience still; science in this instance has confirmed and not suggested practice. Iron has other actions and uses therapeutically, but its chief employment is as a hæmatinic. The particular form in which the metal may be administered is discussed under its own head, but one or two combinations with iron must be noticed here. The Mistura Ferri Composita, an old-established empirical combination of Protosulphate of Iron, Carbonate of Potash, Myrrh, and Aromatics; the Pilula Ferri et Aloes; and the non-officinal pill of Blaud, containing Protosulphate of Iron and Carbonate of Potash, are specially successful remedies in anæmia, the rationale of which will now be obvious to the student. The Phosphate of Iron is also indicated, and is highly successful in some instances. Altogether, the medicinal treatment of deficiency of hæmoglobin practically resolves itself into the continuous administration of iron in some useful form or combination, without impairing digestion or the action of the bowels.

In urgent cases of want of blood corpuscles, whether acutely developed by hæmorrhage, or progressing slowly to an extreme degree, transfusion must be practised.

Reduction of oxyhæmoglobin defies therapeutical measures if it have advanced beyond the very first stage, that is, the treatment of poisoning by carbonic oxide, prussic acid, etc., is rarely successful. It must, however, be attempted. Combined

venesection and transfusion would theoretically be the proper treatment—to remove disorganised blood and poison, and to replace them by healthy corpuscles and plasma. But this is manifestly very rarely practicable. All that can be done, as a rule, is to sustain the circulation and respiration, by general stimulants and artificial respiration, and thus preserve vitality by means of the oxygen and hæmoglobin that may still remain active. In every case it will be proper to do this until transfusion can be undertaken.

SYNOPSIS OF SUBSTANCES WHICH ACT ON THE BLOOD.

SUBSTANCES WHICH ACT ON, OR ARE DECOMPOSED IN THE PLASMA.	SUBSTANCES WHICH ACT ON THE WHITE CORPUSCLES.	SUBSTANCES WHICH ACT ON THE RED CORPUSCLES.
Potassi Iodidum	Quinia	Iodides
Sulphur (Hydrosulphuric Acid)	Veratria	Sulphur (Hydrosulphuric Acid)
Benzoin, Acidum, Benzoic	Myrrha	Quinia
Styrax	Aromatics	Alcohol
Salicylates		Sodium Nitrite
Oleum Olivæ		Spiritus Ætheris Nitrosi
Oleum Morrhuæ		Acidum Hydrocyanicum Dilutum
Succus Limonis		Oleum Terebinthinæ
Potassium		Potassium
Sodium		Ferrum
Lithium		Arseniosum
Calcium		Phosphorus
Magnesium		Tartaric and Citric Acids
Acids		

CHAPTER IX.

METABOLISM—THE ACTION OF MEDICINES—ALTERATIVES.

WE now pass on to consider the process of nutrition or metabolism, that is, the activity of the tissues, the development of force by protoplasm in the presence of blood. We shall find that this subject has an important bearing on the action and uses of many drugs and other therapeutic measures.

I. PHYSIOLOGICAL RELATIONS.

The best means of comprehending the obscure subject of metabolism is to take the instance of a muscle. A muscle has a definite structure; enjoys a free supply of blood; displays force during the period of its contraction, namely, mechanical

energy, heat, and sound; and produces certain chemical substances—carbonic acid, water, sarkolactic acid, kreatin, other allied nitrogenous bodies, and possibly urea. The blood which passes through the muscle becomes venous, that is, loses oxygen and a small quantity of proteids, and takes up the waste products.

In doing this work, the muscle first incorporates the oxygen and other elements of the plasma with its own substance, however loose that combination may be. In this respect the molecules of the muscle are being constantly changed. It is a fact of the first importance to the pharmacologist, that when a muscle or any other living tissue incorporates nutrient materials, acts upon them, and forms force and other products from them, its own molecules are changed or altered. As the blood or plasma supplied varies, so will the materials vary that are incorporated, the amount and even the character of the force and the products, and the chemical—possibly even the anatomical—constitution of the active protoplasm. In one sentence, we may say that the muscle and the plasma act and re-act upon each other: that the protoplasm *acts on* or *alters* the lymph; the lymph *acts on* or *alters* the protoplasm.

This process of double decomposition appears to be going on in every organ and tissue of the body; though, naturally, the tissue being different in each case, so are the particular substances broken up by it, the products yielded by it, and the particular kind of force which it displays, for instance secretion, nervous energy, growth and development. The oxygen and the proteids are carried to the organs by the arterial blood; the heat is distributed and lost; the carbonic acid, water, and nitrogenous and other products are excreted by the lungs, skin, kidneys, and bowels; and the active organs are maintained in size and vigour amidst all the change.

There are various *means of estimating* the state of metabolism in the living body. We may measure, first, the amount of *force displayed*—the muscular activity or *tone*, the rate of growth, the temperature, the mental capacity; or, secondly, the amount of *material consumed*—the food taken and the air inspired; or, thirdly, the *products* of metabolism, that is, the excretions. The first two means are by no means always available with accuracy. This is what makes the examination of the urine, the principal excretion, so important in the majority of clinical cases; for knowing the state of the urine, we can work backwards, as it were, and estimate the functional activity and even the anatomical state of the organs in which its constituents have been produced.

Unfortunately, metabolism is not the simple process which

we have described, but in many respects still very obscure. Thus the proteids are not at once broken down into carbonic acid, water, and nitrogenous compounds, as represented above. In some of the tissues at least there are intermediate products, one of which is fat, which is in turn oxydised into carbonic acid and water. It is also probable that all metabolism is associated with ferments, if not actually due to their activity, like digestion and the coagulation of the blood. Lastly, the intimate protoplasmic changes which are the basis of vital force are controlled by the central nervous system, by *trophic* centres lying in the cord and cerebrum, with afferent and efferent trophic nerves.

II. PHARMACODYNAMICS.

This brings us to the second part of our inquiry—our power over metabolism in a healthy individual. This is greater than would at first appear.

1. Our influence on metabolism through *the blood as a whole*, has been fully discussed in the preceding chapter, and does not require to be more than mentioned here.

2. We can affect nutrition through the *constituents* of the blood which supply material to the particular organs. Experience taught us, long before science, how to feed a man in training for muscular exertion; which kinds of food are specially suited for the exercise of the brain, for the periods of growth and development, of pregnancy and lactation, of degeneration and decay. It is but expressing the same fact in other words to say that by supplying an excess of certain kinds of food, we can increase the activity of an organ, the cells of which appear to exercise themselves more vigorously when their natural source of energy and nutrition is freely supplied to them. Alcohol, Cod-liver Oil, Olive and Almond Oils are thus valuable foods, or **nutritive tonics.**

3. An increased supply of *oxygen* in the blood increases metabolism. The valuable influence of fresh air on active organs is familiar, and we have learned in this connection the use of Iron, which is thus a **hæmatinic tonic.**

4. An increased amount of work is an interesting means of increasing protoplasmic activity. By throwing more weight upon a muscle, up to a certain point, we can increase the force of its contraction. This is *exercise;* but it must be accompanied by a sufficient supply of plasma and oxygen. A man in training, not only selects his food and air, but throws an increased amount of work on his muscles by exercising them regularly.

5. We can influence metabolism by means of the *excretions*, that is, by hastening the removal of its products through the lungs, kidneys, skin, and bowels, as we have already seen in the case of the stomach and liver. The same principle manifestly applies to all the tissues.

6. The *trophic* centres are amenable to impressions carried in by their afferent fibres, and such of these fibres as originate in the surface of the body are thoroughly accessible, and ready to convey any influence which we may impress upon them, such as extremes of heat and cold, by means of the cold bath or douche, stimulation by Mustard or Cantharides, and the direct battery current.

7. The metabolic activity of a part may be increased by certain local measures which are familiar to us, as friction and shampooing. The physiological effects of these **local alteratives** or **local tonics** are very powerful. Their action is complex, partly direct and partly reflex through the trophic nerves. They cause, first, dilatation of the local vessels, leading to increased circulation in the tissues; more rapid removal of the products of nutrition by the lymphatics and veins; and an actual exercise of the tissue elements, *e.g.* of the muscles, by well-arranged movements. No doubt these effects can be increased by the use of certain local circulatory stimulants, in the form of liniments of Ammonia, Alcohol, Chloroform, and the great group of Volatile Oils of the Turpentine and Camphor series. But, further, these local alteratives and tonics react upon nutrition generally, probably through the nervous system, and greatly stimulate it, improving the appetite and digestion, and rapidly causing an increase in the strength and the weight of the body, and thus become **general tonics**. The action of poultices, blisters, some forms of electricity, and other local applications, on the nutrition of deeper parts, which is known as *counter-irritation*, is discussed in chapter xv.

8. The surrounding *temperature* has a powerful effect upon nutrition. Heat and cold are universally recognised as being stimulating, enervating, relaxing, tonic or bracing, as the case may be. Water, in every form, from vapour to solid ice, is a convenient means of bringing any temperature that may be desired into contact with the tissues, whether directly or indirectly through the vessels and nerves. In other words, we possess, and have greatly elaborated, the means of affecting nutrition by baths and climate, the actions and uses of which are the subjects of **balneology** and **climatology**.

9. *Medicines.*—We have made a further important discovery with respect to our influence over metabolism—that we can admit to the organs other than the normal constituents of the

blood, and allow them to participate in the vital processes. Thus, if such foreign substances as Mercury or Arsenic be introduced into the blood, the muscular and other tissues will take them into their substance, just as they take up proteids, salts of lime, and water, and incorporate them in a loose chemical way, their own proper composition being essentially unaltered. By whatever channel they may be introduced into the blood, most of the active principles of the materia medica are carried in the plasma to the tissues and organs, and are said to "act upon" or to "have a specific action" upon them. Thus, Iodine acts upon the glands, Bromine upon the brain, Potash on the heart, and so on. By this expression we mean that the medicines having reached an organ take part in the process of metabolism; that they become loosely incorporated with the anatomical elements of the part; that they form, either in these, or in the presence of these, certain chemical compounds with oxygen, different from the ordinary; that they are cast out again in the metabolic products, either unchanged or in a new chemical form; and that, *in thus passing through the organ and taking part in its activity, they have modified the force which it displays.* Thus, Alcohol, in passing into muscle, becomes oxydised and converted into carbonic acid and water, and in the process of decomposition increases the force of muscular contraction. Alcohol is accordingly said to act specifically upon muscles. So with all tissues and organs: some incorporate from the blood one substance, some another. Just as the life-processes of the various tissues and organs differ from each other, so will some select or be acted on by some principles, others by other principles. Gland protoplasm is acted upon by Iodine, nervous protoplasm by Bromine, muscle protoplasm by Potash, red corpuscle protoplasm by Iron, and so on.

Here it is necessary to offer a word of caution. The expression "action" of a medicine is generally used in a much wider sense than that just indicated. When we say that a given therapeutical substance acts upon "an organ," we do not always mean that it acts upon the *protoplasm* of that organ. When we say that alcohol acts upon the skin, flushing it and increasing its heat and secretion, we do not imply that alcohol is decomposed by the connective tissue-cells of the skin. An organ possesses not only active protoplasmic cells but vessels and nerves; and a vast number of the effects of drugs upon organs are due, as we shall see in subsequent chapters, to their action upon the vessels and the nerves that supply these organs. Ultimately, of course, all drugs do act upon protoplasm in some form, on the protoplasm of muscular tissue, of nerve-ganglia, of the walls of blood-vessels, or of the cells of the nerve-centres

which regulate the vessels. But for practical purposes it is highly important to keep the action of drugs upon the protoplasm of an organ quite distinct from their action upon the organ through its nerves or its blood supply.

Alteratives.—The subject of metabolism introduces us to a term applied to certain drugs, namely, **alteratives.** This word, like many other terms in therapeutics, never had an exact application, and therefore defies correct definition. Still, it is retained as a useful word, and its meaning may be discussed if it cannot be defined. We have seen that we can increase the amount of work done by an organ in several ways, through food, air, local stimulation, etc., which make it build up and break down more actively both its pabulum, the lymph, and its own proper elements: which, in one word, *exercise* it. Certain medicinal substances also are found to **increase metabolism,** the chief of which are Mercury and Iodine, Phosphorus, Antimony, and Arsenic, Sulphur or Sulphides, and certain doubtful vegetable agents, such as Sarsa and Guaiacum. The particular way in which each of these drugs increases tissue waste is given under its own head, as far as it is known. It naturally occurs to us, that the action of these medicines is another form of exercise of the tissues. When Mercury and Iodine, for example, have entered into combination with living protoplasm, and been again disengaged or thrown out of combination with it in the metabolic products, they have *made it do a certain amount of work:* and to a corresponding extent they have effected a change and a renewal of its proper molecules; they have hastened its nutrition; their action may be said to be *alterative.* We find that an essential condition of the success of alterative drugs is a free supply of the normal sources of metabolism, food and air, just as it is of physical exercise, that the constructive part may keep pace with the destructive part of metabolism. If food and air fail, the health rapidly breaks down, the body wastes, and death may result. Possessing a powerful and peculiar action like this, these medicinal agents fully deserve the name of alteratives, and any method of treatment which may be founded upon their action is incomplete unless it include abundant feeding and fresh air.

Opposed to the alteratives are an important class of drugs which **diminish metabolism.** Alcohol has this action, apparently by being itself so readily oxydised in the tissues that it robs the cells, as it were, of oxygen, while it also binds the oxygen more firmly to the red corpuscles, and thus in two different ways spares tissue change. Quinia also lowers oxygenation, and has a further influence in preventing oxydation of protoplasm, which is imperfectly understood. Probably

Alcohol, Quinia, Resorcin, Kairin, Chinolin, and Salicin, also diminish the activity of the natural metabolic ferments.

Complex Measures.—Some of the most powerful means at our disposal for influencing nutrition are a combination of the preceding measures. The best illustration of this is the treatment carried on at a foreign bath, we shall say at Aix-les-Bains, in Savoy. Here an English patient enters a new, a purer, and a warmer atmosphere. His food is reduced in quantity and changed in quality; he has to take active muscular exercise; he enjoys a daily bath, which is really a complex arrangement of washing, rubbing, douching, and frequent change of surface temperature; and he has to drink a definite amount of the waters, which contain Soda, Lime, Magnesia, Iron, and Iodine. Such a combination of measures is manifestly powerfully alterative.

Tonics, which increase the tone or general muscular and nutritive vigour, belong, as we have seen, to several of the preceding classes.

III. Pathological Relations.

The disorders of metabolism are many and complex. Diseases so wide apart as gout, syphilis, and malaria, and disorders so different in their cause and effects as fever and fatty degeneration, are linked together by the fact that they are all affections of nutrition. In this place we can refer but to a few of them, and that very briefly.

The cause of metabolic disorder is most frequently found in the *ingesta*. An *excessive* supply of lymph to the active cells, an unnatural richness of the blood in proteids from indulgence in food, or an insufficient supply of oxygen from insufficient exercise, will disturb general metabolism as they disturb hepatic metabolism, and contribute to the production of the diseases known as obesity and gout. *Deficiency* of plasma is a result of anæmia, as we saw in the last chapter; and since it generally accompanies aglobulism and deficiency of oxygen, the result is feebleness of metabolism throughout the entire body. Metabolism is also disturbed by sudden and extreme alterations of *external natural influences*, such as the temperature, moisture, pressure and electrical condition of the air; and local changes of temperature give rise to chills, colds, and rheumatism. The opinion, however, is daily growing that fever and many other disorders of metabolism are often due to the entrance into the tissues of *unnatural, extraneous*, or *infective* substances, whether inorganic, organic, or organised, such as foul air, the contagia of measles, scarlatina, and other exanthemata, and the organisms of malaria, syphilis, and tuberculosis. It is suggested that these organisms interfere with metabolism by

settling in the tissues and carrying on an indepent metabolism of their own, that is, by living, thriving, and reproducing their like at the expense of the pabulum of the tissues; that they throw the products of their changes into the venous current, which is thus poisoned and infects the rest of the body; and that by their life-changes they cause a development of heat which constitutes one part of fever.

The *phenomena* of disordered metabolism are necessarily of endless variety and complexity. The most striking symptoms attend that kind of excessive nutrition known as *fever*, viz., wasting, increased excretion, high temperature, and general functional derangement. To this subject we shall return in chapter xiv. *Inflammation* may be broadly defined as a similar increase of metabolism in a local form. Defective local nutrition is seen in fatty and calcareous *degenerations*. In some forms of derangement the results are chiefly appreciable in connection with the tissues themselves, as in obesity; in others they are discovered in the excretions, *e.g.* gravel, and glycosuria; in many instances, such as gout, they can be found both in the tissues and excretions. Occasionally they take the form of excessive and unnatural *growth*, invading and destroying the normal structures, as in cancer. In other diseases the growth is rapidly followed by decay, as we see in syphilis and tubercle. When the derangement remains persistently, and establishes itself in the organs, without definite anatomical change, it constitutes in part the so-called *diatheses*—gouty, rheumatic, calculoid, etc. Manifestly in this great collection of diseased conditions we have an urgent demand for treatment.

IV. Natural Recovery.

Experience has taught us that many of the most common derangements of metabolism, such as fever, gravel, and rheumatism, are of but temporary duration, that is, disappear spontaneously, when the normal conditions have returned or are restored. The forms which natural recovery takes in metabolic disorder are known as *reaction and repair*, *i.e.* increased nutritive activity, often associated with *inflammation*. Unfortunately this class of derangements are peculiarly liable to recur, but this is chiefly because of the return of unhealthy circumstances. Here, too, as elsewhere, recovery is limited by anatomical changes; but even growth and degeneration will sometimes disappear, under favourable conditions.

V. Therapeutics.

The rational treatment of disorders of nutrition is a subject of such large proportions that it can be discussed only in an

illustrative way in the present work. A careful consideration, however, of the principles laid down under the preceding heads will, it is hoped, enable the student to extend his knowledge practically on his account.

The general treatment of disorders of metabolism involves the regulation of the whole manner of living: of the food and air, the work done, the excretions, and, above all, the careful balance of these. Muscular and nervous exercise must be ordered in fair proportion, to prevent obesity and gout on the one hand, or exhaustion and degeneration on the other.

When an actual instance of metabolic disorder demands treatment, we must first attempt to *discover its cause, and to remove it* by the same measures which might have prevented it. Thus the cause of gout may be swept from the system in many instances by a timely and thorough reform of the diet, and stimulation of the bowels, liver, and kidneys by a combined cathartic and cholagogue, followed by a saline, as recommended under the head of the Liver. Lead poisoning may be cured in the same way, by hastening the excretion of the metal by Iodide of Potassium. When these or other disorders of metabolism, such as rheumatism, syphilis, and tuberculosis, have become chronic, great benefit is derived from change of air and treatment by natural baths. We can sometimes remove fatty degeneration, that marked instance of imperfect metabolism, by removing its cause—an imperfect blood-supply, local or general, *e.g.* by Iron. In other cases we may attempt to destroy, if we cannot remove, the cause; thus it is possible (but not certain) that Mercury partly cures syphilis by directly destroying its virus; Quinine malaria; and Salicin rheumatism.

As a rule, however, in the more pronounced, the so-called specific, forms of disordered nutrition, such as tuberculosis, cancer, and syphilis, all that we can do is to *counteract the cause, and relieve or remove its effects;* that is, to treat symptoms. The specific fevers, such as typhoid and scarlatina, must be similarly treated symptomatically, for their course cannot be arrested. The pyrexia is combated by febrifuges or antipyretics, which we shall discuss fully in another chapter; the waste is repaired by nourishment; and other symptoms are relieved as they arise. Inflammation and its effects—abscess, effusions into cavities, growths, adhesions, and so on—will be treated by local stimulants or alteratives, such as poultices; friction with alcoholic, aromatic, and oily preparations; douching, baths, blisters, etc., to which we shall return in chapter xiv.; or they may demand surgical interference. In other kinds of metabolic disorders, such as tuberculosis (phthisis, consumption),

we have to direct a considerable part of our treatment to the maintenance of the general nutrition, by preserving digestion, and giving highly-nutritious foods, such as Cod-liver Oil until the process has temporarily spent itself, and ended possibly with the evacuation of the diseased parts.

The question of the treatment of syphilis, chronic gout, rheumatism, and a number of local diseases probably related to these, for example, of the skin, joints, and nervous system, introduces us to the *use of alteratives*. We saw that alterative drugs act by *exercising* the tissues, and we have now to point out how exercise benefits an organ actually the seat of disease. For instance, syphilis is characterised locally by masses or patches of small-celled growths, with peculiar anatomical relations, proceeding probably to ulceration, that is, to death of the part. How do Mercury and Iodine remove these growths and thus cure the syphilis? In answer to this question it may be said that there are two ways in which it may be desirable to exercise tissues. First, there may be need of increased metabolic change in order to remove excessive growth. Mercury and Iodine act, partly at least, in this way upon syphilitic growths. They hasten the life-processes of the young cells so much, that the cells disappear in the form of products, or, as it is commonly expressed, "are absorbed." It is essential to the success of this plan of treatment that the alterative substances should be thoroughly under control, and, as we have seen, that abundant food and air be ingested to prevent failure of nutrition.

Secondly, there is an effect of exercise beyond an increase of work accomplished: work that is increased in *amount* can be changed in *kind;* exercise is beneficial, not only to the indolent individual, but to the vicious. So with the tissues. Exercise may bring them into a new, a normal, state of function, when they have been deranged or even diseased. In order to get the tissues to work normally, we must get them to work *somehow*, knowing that such work means chemical change, or even active nutritive renovation of the elements. The natural disposition which all tissues inherently possess to return to the normal, is thus afforded an opportunity of coming into play; and the result is, not a mere increase of activity, but also an *alteration in kind* of the activity. Henceforth the protoplasm, if supplied with an abundance of food and oxygen, itself returns to the normal state. This powerful effect of alterative drugs is seen in such diseases as chronic gout, skin diseases, rheumatism, and disorders of the nervous system. Besides Iodide of Potassium, the alteratives used for this second purpose are chiefly Arsenic, Silver, Antimony, Phosphorus, and occasionally Copper and

Zinc. Sulphur is a mild alterative, valuable in rheumatism and skin diseases, especially in the form of natural waters. Many vegetable substances are credited with like properties, notably Sarsaparilla, Guaiacum, Hemidesmus, Serpentary, and Mezereum, but the physiological action of these is very obscure, and their value as medicines doubtful.

SYNOPSIS OF DRUGS WHICH INFLUENCE METABOLISM

SUBSTANCES WHICH INCREASE METABOLISM. ALTERATIVES.	SUBSTANCES WHICH DIMINISH METABOLISM.	LOCAL STIMULANTS. LOCAL ALTERATIVES.
Hydrargyrum	Oleum Morrhuæ.	Cadmium
Ferrum	Oleum Olivæ	Iodum
Antimonium	Glycerinum	Sulphur
Phosphorus	Alcohol	Water
Arsenicum	Quinia	Fixed Oils
Sulphur	Salicin and Salicylates	Alcohol
Calcii Sulphidum	Resorcin	Æther
Calcii Chloridum	Chinolin	Chloroformum
Calcis Hypophosphis	Kairin	Ammonia
Sodæ Hypophosphis		Volatile Oils
Water		Oleo-Resins
Guaiacum		Resins
Hemidesmus		Balsams
Mezereum		
Sarsa		
Caffein		
Guarana		
Coca		

CHAPTER X.

THE CIRCULATORY SYSTEM.

I. PHYSIOLOGICAL RELATIONS.

THE function of the heart is to drive a certain amount of blood through the whole length of the circulatory system within a given time. In its flow through the small arteries and capillaries, the blood meets with great peripheral resistance, and is dammed back, as it were, upon the larger arteries, which by virtue of the elasticity of their coats are constantly distended, and exert an equal and opposite pressure on the blood. The intermittent action of the heart is thus converted into a continuous force, *the arterial blood-pressure*, which (thanks to the aortic valves) urges the blood forwards in a steady stream.

The surface of the blood-stream is broken only in the arteries by the wave raised by each fresh discharge from the heart, and this wave is called *the pulse.*

The *heart* performs its work by virtue of being a nervo-muscular organ, freely supplied with blood by the coronaries. The muscular tissue is normally stimulated to contract by the intra-cardiac ganglia, which, whilst automatic in action, are excited by impressions coming from the inner surface of the heart—chiefly impressions of pressure or resistance; and the vigour of systole is in direct proportion to this pressure, which in turn is referable, partly to the auricular charge, and partly to the resistance ahead. The movements of the heart are regulated by the cardiac centre in the medulla, which is that part of the nervous system where afferent impressions are first received, and then reflected as motor impulses to the heart, either by the vagus or by the sympathetic, the *terminations* of which are connected with the cardiac ganglia. An impression made upon the terminations of the vagus diminishes the frequency of the nervous discharges from the ganglia, that is, *inhibits* the contractions of the heart; an impression made on the terminations of the sympathetic accelerates them. With regard to the heart- or pulse-rate, it is highly important to observe that the *length of systole varies very little:* whatever the work done or to be done, the ventricle takes $\frac{4}{10}$" to contract. The part of the cardiac revolution that varies in length is the diastole, which is sometimes long, giving an infrequent pulse-rate, say 50, sometimes short, giving a frequent pulse-rate, say 100. Now, during diastole the nervo-muscular apparatus rests and is nourished, and the ventricles are filled from the auricles and veins. An infrequent pulse is thus (to a certain extent) an indication that the heart is being rested and filling well, whilst the force of the systole is not weakened, probably the reverse, by these two effects. Agencies which thus affect the rate of the heart through the terminations of the vagus and sympathetic, either reach them through the coronary blood, such as drugs, or are transmitted from the central nervous system through the nerve-trunks. Central impulses affecting the *force* of the heart probably reach it through the same channels.

The *cardiac centre* in the medulla is the centre of an area of impressionable matter, which is as extensive as the nervous system itself. Into this centre there pour constant streams of impressions from the vessels, abdominal viscera, skin, muscles, central nervous system (including the seat of mind), from the lungs, and indeed from every organ, including the heart itself; and thence the resulting impulses descend through the vagus and sympathetic to the heart, which is thus subject to every

influence, however slight, to which the body may be exposed. Further, the cardiac centre is affected by its blood-supply, including both the quality and pressure of the blood within it.

Amongst the afferent impressions reaching the cardiac centre, those from the heart itself travel through the vagus. These are partly impressions of common sensibility, which pass through the medulla into the convolutions; and although normally too feeble to be perceived, may, if powerful, give rise to sensations of pain, distress, weight, and palpitation, referred to the præcordium.

The *arteries* are active, irritable muscular tubes, whose calibre can be modified by a variety of influences. A local nervous mechanism guides the vasor muscles; vaso-motor and vaso-dilator nerves pass between the local mechanism and the central nervous system; and there is a great central point in the medulla oblongata, called the *vaso-motor centre*, as well as other lower centres in the cord and brain, which collect impressions from every part of the body, and reflect them through the vaso-motor or vaso-dilator nerves, as the case may be, to the vessels. The muscular coat of the arteries, being constantly exercised to a degree, gives so-called "tone" to the vessels, which is one of the elements of that cardinal factor of the circulation, *the peripheral resistance*. The more active the vaso-motor nerves or centres, the greater the resistance and the higher the blood pressure; the more active the dilator, the lower the pressure; and the influence of each upon the heart respectively corresponds. Particular vascular areas, *e.g.* those of the skin and mesentery, may also be dilated or constricted independently of others. Manifestly local dilatation will admit more blood to the part, and so lower the general arterial pressure; local constriction will increase the local resistance, and so raise the general pressure. Amongst the impressions which influence the vaso-motor centre are mental states, visceral conditions, surface temperature and sensations of all kinds. It is also stimulated by deficiency of blood within itself, and by poverty of the blood in oxygen, and drugs act directly upon it as we shall presently see.

The afferent impressions which reach the vaso-motor centre from the heart are so important to the therapeutist that they demand special mention. When impressions originating in over-distension, distress, or failure of the heart, reach the cardiac centre through the vagus, they are transferred to the vasor centre, whence they are reflected to the vessels through the dilator nerves. The vessels are thus relaxed; the arterial pressure, which the ventricle has to overcome, falls; the heart empties itself more readily, and is relieved. This arrangement

for reducing the intercardiac pressure is called the *depressor mechanism of the circulation.*

The *capillaries* effect the final distribution of blood to the tissues. Their soft protoplasmic walls, through which the plasma, the oxygen, and the corpuscles pass into the tissues, have irritability of their own, and they are subject to many other influences, viz. those of the nervous system, of the blood which they contain, of the arteries and the veins at either extremity, and of the activity of nutrition. In the capillaries we discover the other element of the *peripheral resistance.*

The *veins* convey the blood back to the heart as comparatively passive tubes. They are probably subject to special nervous influences, but they are chiefly influenced physically by the volume of blood passing through them, that is, by the condition of the heart in front and of the arteries and capillaries behind. Thus, shortness of diastole, *i.e.* frequency of the heart, diminishes the time of emptying the veins, and raises the pressure within them. A low arterial pressure and a free flow through the capillaries have the same effect. Conversely, the veins react physically on the heart and capillaries; if they are dilated and full, the return of the blood to the auricle is delayed, and the force of systole weakened from lowness of the charge, whilst the capillaries are obstructed, and the flow of the plasma and metabolic products between the vessels and the tissues disturbed.

We can now understand the meaning of the expression, *the general blood-pressure.* The elasticity of the arteries being taken as constant, the pressure of blood within the arterial system at any given moment will depend upon (1) the total quantity of blood in circulation; (2) the action of the heart; (3) the freedom of the flow into the veins, *i.e.* the peripheral resistance, due to vasor constriction and capillary obstruction. The arterial pressure is so far self-regulated, through the quantity of blood in circulation, by means of the Malpighian bodies of the kidney. In this mechanism, the general arterial pressure is brought to bear upon a length of unsupported arteriole, so as to press or excrete the water of the blood through the vascular wall into the uriniferous tubule. By the muscular and nervous structures in the walls of the afferent and efferent arterioles, the pressure upon the glomerulus may be cut off, or thrown on, as the system requires, the result being less or more watery excretion, and corresponding rise or fall of the blood pressure. The perspiratory excretion, and, indeed, all exudations, probably act in the same way as the urinary, only less powerfully.

Another powerful influence on the circulation as a whole is muscular activity, exertion being attended by cardiac excite-

ment and high arterial pressure, and muscular rest by calm action of the heart and a quiet pulse.

II. Pharmacodynamics.

The circulatory system affords one of the most striking instances in the body of provisions for physiological change, and of functional reaction to influences of every kind which bear, or may be brought to bear, upon it. Herein lie at once its power of accommodation to circumstances and its vulnerability; and here, too, the therapeutist discovers his opportunity of influencing the heart and vessels at his pleasure.

1. The *total volume of blood in circulation* being one of the prime factors of the blood pressure, every change in this volume, whether by abstraction or addition, must alter the pressure. This can readily be accomplished by leeching, cupping or *venesection* on the one hand, or by *transfusion* on the other hand. As a matter of fact, however, the effect of either method on the circulation is but temporary. The tension of the pulse falls with venesection, only to rise again quickly by increased absorption of fluids from the tissue and bowels into the circulation. Transfusion raises the blood pressure for a time, but the compensating mechanisms soon restore the previous average pressure. Venesection is therefore the most powerful of all measures for quickly taking the tension off the whole circulation, and relieving the heart and lungs, but it is practically useless for the purpose of permanently reducing the blood pressure; and transfusion is similarly of inestimable value in rapidly restoring the pressure, if it have fallen dangerously low from loss of blood, and thus preventing death by circulatory failure.

2. *The Heart.—a. The intrinsic nervo-muscular apparatus* may be either *stimulated* or *depressed.* The first direct cardiac *stimulant* is an active coronary circulation, through which the heart responds to improved quality of the blood in oxygen and plasma, and thus, indirectly, to proper air and food, healthy digestion, and hepatic action. Direct cardiac stimulants include many drugs, such as Alcohol, Digitalis, Scilla, Strychnia, Ammonia, Ether, etc. The continuous battery current applied through the region of the heart acts similarly. *Reflex* stimulation is a ready and powerful means of increasing the activity of the heart, or of rousing it in actual arrest, and includes the various methods of local nervous stimulation described in chapter xi., especially irritation of the fifth nerve by Ammonia, the cold douche and flagellation, and counter-irritation of the præcordium. Cupping and leeching also exert a stimulant influence on the heart through the nervous system, as well as relieving it by abstraction of blood. Carminatives stimulate

the heart, partly directly, partly by reflexion through the central nervous system of their impression on the gastric mucosa. *The mind* is a powerful instrument for invigorating the heart. Cheerfulness and encouragement may be more useful to a patient than many drugs. Lastly, all measures which lengthen the diastole (slow the heart) increase the cardiac strength by affording more time for rest.

The intrinsic nervo-muscular apparatus may be *depressed* or *soothed* by the opposite set of measures; by a low coronary pressure, the effect of low diet, purgatives, diuretics, and diaphoretics; by arresting reflex impulses by means of general, peripheral, and central nervous sedatives, such as Opium, warmth, or plasters applied to the præcordium, and the general warm bath; and by all measures which shorten the diastole, *i.e.*, increase the rate of the pulse. Lastly, we have a number of drugs which are direct cardiac depressants, including Opium, Diluted Hydrocyanic Acid, Aconite, Antimony, Potash, Chloroform, Chloral, Ergot, Veratria, Ipecacuanha and many more.

The *afferent nerves of the heart*, which carry to the brain the impressions of common sensibility originating in the cardiac tissues, may be depressed by means of Opium, Chloral, Belladonna and its allies, and possibly by heat and cold.

b. The terminations of the vagus in the heart may be *stimulated*, and the cardiac action rendered less frequent, by Digitalis and Scilla. The same part of the inhibitory mechanism may be *depressed*, and the rate of the heat increased, by Belladonna, Hyoscyamus, Stramonium, Amyl Nitrite, and large doses of many drugs. These local measures act very powerfully.

c. The *cardiac centre* in the medulla is readily *stimulated* by certain drugs, such as Digitalis and Scilla, Ether, Alcohol and Chloroform at first, Strychnia, and Belladonna; and by many peripheral nervous impressions, such as counter-irritation and cold. On the other hand it can be *depressed* by warm applications to the surface, such as the hot bath, and by certain drugs, including Chloroform and Alcohol after the first stage, Aconite, Antimony, Opium, Chloral, Diluted Hydrocyanic Acid, Ipecacuanha, Nitrite of Amyl, Physostigma, and Conium. Our control of the inhibitory action of the vagus at either extremity, that is, of the frequency of the heart, is of much value from the power which it affords us of influencing the cardiac nutrition and strength, by lengthening or shortening the diastole or resting-time of the ventricle. Thus it will be found that all cardiac retarders are cardiac stimulants, whilst all cardiac accelerators prove in the end to be cardiac depressants.

In this connection muscular *exercise* and *rest* must be mentioned as the most powerful and available of all the

measures which increase and diminish, respectively, the work and nutritive activity of the heart. Rest in bed, avoidance of walking, carriage exercise, movement on level ground, are a descending series of means of giving the heart rest, and the different kinds of wholesome muscular exercise are equally valuable means of throwing work upon the heart, when its condition demands increased activity.

3. *The Arteries.*—The peripheral resistance in the arteries introduces us to a vast number of pharmacodynamical influences which we must be content simply to enumerate:

a. The vaso-motor centre can be *stimulated* directly by Alcohol and Chloroform (temporarily), by Ether, Ammonia, Strychnia, Digitalis, and Scilla; by irritation of the sensory nerves in any accessible part of the body—for instance, by cold, counter-irritants such as mustard, etc., applied to the calves or soles, by stimulation of the trigeminus, the most ready and powerful means of which is Ammonia held to the nose. On the other hand, the vaso-motor centre may be directly *depressed*, by Alcohol and Chloroform in the second stage, by Opium, Chloral, Diluted Hydrocyanic Acid, Antimony, Ipecacuanha, Aconite, Belladonna and its allies; by muscular rest; by emotional quiet and balance; and by local sedatives, such as anodynes, warmth, and gentle friction.

b. The local vaso-constrictor mechanism in the arterial walls is stimulated directly by Lead and Silver, Digitalis and Squill, in the first stage, Ergot; and by local cold, produced by irrigation with water, by Ether spray, or by evaporation of spirituous, acid, and saline solutions, such as lotions of Rectified Spirit, Vinegar, and Chloride of Ammonium. We call these measures **vascular astringents.**

Vascular *dilatation* may be effected through the same local mechanism by the Nitrites of Amyl and Sodium, Nitroglycerine, Alcohol, and Belladonna; by the local heat afforded by poultices and fomentations; by the whole group of Volatile Oils, of which Turpentine and Camphor are the types; by Acrid Oils, including Mustard and Mezereon; by irritant metals and metalloids, such as Zinc, Copper, and Iodine; and artificial carbon compounds, including Creasote, Carbolic Acid and their allies. Local vascular dilators are naturally **local circulatory stimulants.** The continuous current also causes local vascular dilatation.

4. *The Capillaries.*—As one of the causes of peripheral resistance, the condition of the capillary areas is an object of great interest to the therapeutist. We can *dilate* the capillaries and increase the flow through them by either local warmth or persistent cold, by friction, and by local nervous irritants, such as the confined vapour of Spirits, Mustard, Aromatic Oils, and other rubefacients. This is but an early stage of the process of in-

flammation, characterised by capillary dilatation and escape of the constituents of the blood, which can be induced by a continuation of the same measures, or by excessive heat, Cantharides, Croton Oil, etc. (vesicants and pustulants), and markedly modifies, as we shall see in chapter xiv., the capillary circulation of neighbouring parts, and the general blood pressure.

On the other hand, we can *contract* the capillaries and diminish the flow through them by the application of excessive local cold (congelation and refrigeration), by Lead, and Silver, which are pure astringents; and by the **constringents**, namely, Tannic and Gallic Acids, and the many vegetables which contain them (Kino, Catechu, etc.), which constringe or "tan" the connective tissues supporting the delicate capillaries, by condensing their gelatinous and albuminous constituents. Some substances, such as Persalts of Iron, may also arrest the circulation in the capillaries, by promoting coagulation of the blood within them.

5. Our influence upon the walls of the *veins* appears to be but small. The veins of a part may be dilated by hot applications; contracted, and then dilated, by moderate local cold. Ergot is believed by some authorities to relax the venous walls. Indirect measures are more powerful in our hands. The heart *a fronte*, or the arterial pressure *a tergo*, may be employed, as we have seen, to increase or diminish the venous pressure. The processes of secretion and excretion are not less powerful in modifying the fulness of the veins. Thus, hydragogue purgatives, as we have seen, drain the portal system; and we shall afterwards find that saline diuretics relieve the renal veins in a very similar way.

III. Pathological Relations.

The complex circulatory apparatus is subject to many forms of derangement and disease, a few only of which require to be noticed for the purpose of illustrating the application of drugs and other therapeutical measures.

1. *Disorders* of the heart and vessels belong chiefly to three classes, according to their causes: (*a*) They may be due to direct *nervous* causes, such as mental excitement or depression, or to some cause acting reflexly through the nervous centres in the medulla, such as derangement of the stomach, intestines, uterus, etc. (*b*) They may originate in morbid states of the *blood*, especially anæmia, which disturbs the centres in the medulla, the vessels, and the nervo-muscular structures in the heart. Or (*c*) they may be traced to a *poison* in the system, *e.g.* tobacco, tea, alcohol, lead, and the poison of gout, each of which has a specific action on some part of the mechanism.

2. *Organic disease* will be sufficiently illustrated by a well-marked case of progressive heart disease from some morbid state of the aortic valves. These valves, from their position and constant movement, are peculiarly subject to disease. They thus become distorted or even destroyed, and rendered unfit to direct the movements of the blood, which is consequently obstructed in its exit from the heart in systole, and regurgitates from the aorta during diastole. The great power of adaptation to change of circumstances possessed by the circulation is generally sufficient to *compensate* for moderate valvular disease, by hypertrophy of the muscular walls of the heart. The serious symptoms set in *when compensation fails, i.e.* as a rule, when the nutrition of the ventricular wall is insufficient to supply the increased—possibly ever-increasing—demand for muscular force. The order of events is then as follows: systole fails to overcome the intraventricular pressure; the chamber is imperfectly emptied, and therefore over-distended in diastole; the walls are stretched; and the cavity is *dilated*. Pain and "oppression" make their appearance at this stage, and cause great distress. Henceforth derangement proceeds apace. With the dilatation of the chamber, the mitral valve becomes incompetent or misfitting; blood regurgitates in systole into the left auricle; the pulmonary circulation becomes over-distended; the obstruction makes itself felt in the right ventricle; and, after a time, in the right auricle, by forcing the tricuspid. The systemic veins now become congested from obstruction *a fronte;* the viscera become loaded with venous blood; their functions are disordered; and hæmorrhage, dropsy, fluxes of plasma from the bowels and bronchi, and discharges of albumen in the urine occur. These derangements, coupled with those of respiration, the cardiac distress, and the effects of anæmia from imperfect arterial supply, finally render life impossible. During this process of backward dilatation, the cardiac action is necessarily disordered in all respects, the strength and regularity of the pulse giving way, and its rate being decidedly accelerated.

3. *Hæmorrhage.*—Bleeding produces certain effects on the system, partly referable to loss of blood, and partly to fall of the blood pressure. It is naturally arrested by this fall of pressure, by coagulation of the blood at the seat of disease, and by retraction of part of the coats of the vessel. If the hæmorrhage be severe, fainting or *syncope* occurs, that is, loss of consciousness from failure of the heart and consequent deficiency of blood and blood pressure in the brain. Any other cause of cardiac failure will produce the same effect. At the same time, the weight of the body cannot be supported on account of

the general muscular paralysis, which is another result of the cerebral anæmia; and the patient falls. The recumbency fortunately has a favourable effect: it restores the circulation through the cardiac and vaso-motor centres, increasing their activity; and renders the cerebral centres more responsive to afferent impressions.

IV. Natural Recovery.

The whole circulatory system is furnished with so many and so accurate regulating and compensating mechanisms, that not only the great range of normal conditions to which it is exposed, but even many morbid changes, can be successfully met. The chief of these provisions for preventing or counteracting disease are the reserve force of the heart; the power of compensatory hypertrophy; the depressor mechanism; the arrangements for relief of the vessels by escape of the fluid portions of the blood through the kidneys and bowels, and into serous spaces; and the natural mode of recovery from hæmorrhage and syncope. All these methods of natural relief or recovery are full of suggestions to the therapeutist, and rational treatment must follow nature's lines. The two circumstances which chiefly set a limit to compensation are failure of the coronary arteries to supply the hypertrophied walls, and suddenness of the cardiac lesion, which may hopelessly disturb the circulation before there is time for hypertrophy to occur.

V. Therapeutics.

Although the details contained in the four preceding sections are very numerous and complex, the rational therapeutics of the diseases of the heart and vessels can be sufficiently illustrated by a few simple principles. The grand fact that stands out prominently amongst all the others is that dilatation must be prevented or relieved. It is a purely physical effect or state, resulting from the failure of the great physiological condition on which alone the circulation can be and is carried on, namely, that the driving power must always be greater than the resistance, *i.e.* whilst it varies with it, it must never fall below it. There are many other indications for treatment, but none that approach this in importance.

The general treatment of disorder and disease of the heart will mainly consist in ensuring an equable manner of life. Extraordinary influences of every kind, bodily and mental, especially exertion and excitement, must be shunned by persons suffering from cardiac disease, or in whom any of its common causes may be at work. When disease attacks the valves (endocarditis), *e.g.* in acute rheumatism, absolute bodily rest

is essential to relieve the strain from them and the frequency of their movements; and cardiac depressants, such as Potash, Aconite, and Veratria, are employed to assist this effect.

Removal of the cause is rarely practicable in heart disease. The opposite is the case in cardiac disorder. Treatment here consists in relieving dyspepsia, in restoring the condition of the blood, in securing mental rest, and in removing all poisons from the system, such as alcohol, tea, and tobacco, by a reformation of diet and personal habits. Carminatives are specially valuable in dyspepsia with palpitation.

A great part of the treatment of diseases of the heart consists in *counteracting the cause*; that is, in *the prevention and removal of dilatation.* The first rational step to be taken is to lighten the load upon the heart, to lower the intra-ventricular pressure which it is unable to overcome. Rest, bodily and mental, is the most obvious and easy means of doing so, the patient being kept in bed, and every kind of exertion and excitement forbidden. The pressure may be further reduced by purgation, which diverts and drains the blood; or, if the condition be urgent, blood must be removed by leeching, cupping, or venesection, all of which may give great relief, or even preserve life when it is threatened. In another class of cases, the arterial tension may be lowered by means of drugs. Nitrite of Amyl acts very swiftly in this way, giving relief in that terrible form of acute distension of the heart which is called "angina pectoris," by instantly relaxing the vessels in front, as well as by accelerating the cardiac action. The same effect may be more slowly produced by the alkaline Nitrites, Potash salts, and Belladonna.

The second means of treating dilatation is by *increasing the cardiac power by direct cardiac stimulants*, such as Digitalis, Scilla, Alcohol, and Ammonia. Mustard or other rubefacients applied to the præcordium are *indirect* cardiac stimulants of great value in these cases. At the same time, the quantity and quality of the blood supplied through the coronaries to the cardiac walls must be sustained by nutritious food, and possibly by Iron: a system which demands, in turn, the strictest attention to the action of the stomach, bowels, and liver, flatulence and other digestive disturbances being highly dangerous to a weak heart.

The third means of treating dilatation is by *increasing the time of cardiac rest.* Three powerful direct cardiac stimulants, Digitalis, Scilla, and Convallaria, have the additional action of stimulating the inhibitory apparatus, both in the heart and medulla. They increase the force of the systole, thus thoroughly emptying the chamber, and preventing over-disten-

sion; they lengthen the time of filling the heart, that is, of emptying the veins, thus favouring the venous flow; they afford rest to the heart; and they also increase the arterial pressure, not only by filling the aorta better, but by stimulating the vaso-motor nerves. They are therefore indicated in that backward dilatation of chamber after chamber, ending in dropsy and visceral congestion, which we have discussed, and as a matter of fact they prove of the very greatest value in practice.

Removal of effects: Treatment of symptoms.—Cardiac pain, oppression, anxiety, and other forms of distress, can be relieved by cardiac sedatives, such as local heat or cold, Opium, Chloral and Belladonna. Of these, Opium is the most powerful, and of the greatest value. We must never forget, however, that in Opium we are administering a dangerous cardiac depressant, which paralyses in large doses every part of the circulatory apparatus; and the same remark applies to Chloral. The perfection of the therapeutic art is to use these remedies with judgment. The hypodermic injection of Morphia sometimes gives complete relief. Belladonna is a cardiac anodyne much more easily employed, because less depressant; but is much less efficacious. It is frequently applied locally to the præcordium as the Emplastrum. A rubefacient or even slight vesicant effect on the surface of the chest quickly relieves cardiac pain. Pulmonary distress from congestion of the bronchi and alveoli may be specially relieved by stimulant expectorants, such as Ammonia and Scilla, which increase and remove the bronchial flux; but here again the value of rational treatment is seen in the disappearance of dyspnœa, hæmoptysis, cough, and the physical signs of pulmonary engorgement, under the influence of purely cardiac remedies, such as Digitalis and Alcohol. Dropsy may be immediately relieved by puncture of the part, but like other symptoms disappears rapidly by the veins when the cardiac strength is restored. The same remarks apply ot the visceral congestions and their temporary relief by purgatives. Diuretics are of great service in cardiac dropsy, acting partly by relieving the renal veins (salines), but chiefly by raising the arterial pressure (Digitalis and Scilla), as is fully discussed under the head of The Kidney in chapter xii.

Hæmorrhage — Hæmostatics.—External hæmorrhage is readily arrested by surgical means. If the lesion be internal, as in the stomach or lungs, we must trust chiefly to medicinal remedies which are known as **hæmostatics.**

(*a*) So far the *cardiac depression* caused by the hæmorrhage may be cautiously encouraged. In every case it is desirable to employ all available means of reducing the force, not the power of the heart, especially bodily and mental rest; and for this

purpose general sedatives—Opium especially—are valuable adjuvants to the more direct measures.

(*b*) It is also desirable to take the pressure of the circulation off the bleeding point by *dilatation of a vascular area* in the neighbourhood, and in anastomotic connection; or by inducing a watery flux from it. Thus we employ purgatives in hæmorrhage from the stomach, due to portal congestion, in hæmoptysis or bleeding from the respiratory passages, and in cerebral hæmorrhage, so as to dilate the mesenteric vessels and produce a hydragogue action on the bowels.

(*c*) The *local* measures employed for hæmorrhage are variously known as **local hæmostatics, styptics**, or local vascular astringents. They are imitations or adjuvants of the natural means just analysed, and belong to three distinct classes, according as they act upon, (1) the *blood*, (2) *the vessel walls*, or (3), the *perivascular tissues*.

(1) Hæmostatics may act upon the *blood*, hastening coagulation or precipitating albumen, and thus stopping the bleeding point. Such are Tannin, and the many vegetable substances containing it—Kino, Rhatany, Catechu, Logwood, Galls, Oak-bark, etc.; Alum, Persalts of Iron, Sulphate of Copper, Sulphate of Zinc, Acetate of Lead, Nitrate of Silver, and Diluted Mineral Acids. Matico probably acts physically.

(2) The hæmostatics which promote *contraction of the broken vessel* are Nitrate of Silver and Acetate of Lead—both very powerful; Ergot; and local cold.

(3) Substances acting upon *the perivascular tissues* may be made to arrest hemorrhage by combining with the connective tissues, coagulating or precipitating their albuminous substances, and rendering them more compact than normal, or constringed so that the bleeding vessels are compressed and closed. Such are—Tannin and its allies just enumerated, Lead, Silver, Persalts of Iron, and Alum.

Syncope.—Syncope demands prompt treatment. Nature suggests the first step: the patient must be laid down, with the head at least as low as the heart, so as to restore the pressure and the blood in the cardiac centre. Every possible means must then be used to restore the suspended action of the heart, including direct and indirect cardiac stimulants. The most available of these internally are Ammonia and Alcohol in the form of spirits, or wine; externally, the application of cold, fresh air, flagellation or flicking with wet towels, ammonia held to the nostrils, and the continuous current to the præcordium. Nitrite of Amyl acts quickly in some cases. If swallowing be impossible, Brandy or Ether must be injected into the rectum, or under the skin.

Substances which act upon the Circulatory System.

Substances Stimulating Cardiac Centre.

Digitalis
Scilla
Convallaria
Belladonna (at first)
Stramonium (at first)
Hyoscyamus (at first)
Tabacum (at first)
Alcohol (at first)
Æther (at first)
Chloroformum (briefly)
Veratria (at first)
Physostigma (briefly)
Opium (briefly)
Ammonia
Strychnia

Substances Depressing Cardiac Centre.

Digitalis (at last)
Scilla (at last)
Belladonna (at last)
Stramonium (at last)
Hyoscyamus (at last)
Tabacum (at last)
Alcohol (at last)
Æther (at last)
Chloroformum (at last)
Chloral Hydras
Acidum Hydrocyan
Veratria (at last)
Aconitum
Physostigma (chiefly)
Opium (chiefly)
Antimonium
Ipecacuanha
Conium
Amyl Nitris
Nitrites

Substances Stimulating Nervo-muscular Apparatus.

Digitalis (at first)
Scilla (at first)
Camphor (at first)
Strychnia
Alcohol
Ether
Convallaria
Veratria (at first)
Senega (at first)
Opium (briefly)
Ammonia

Substances Depressing Nervo-muscular Apparatus.

Antimonium
Bromum
Digitalis (at last)
Scilla (at last)
Camphora (at last)
Belladonna (at last)
Hyoscyamus (at last)
Stramonium (at last)
Lobelia
Arnica (at last)
Tabacum
Alcohol (at last)
Æther (at last)
Chloroformum
Chloral Hydras
Acidum Hydrocyanicum Dil.
Aconitum
Ol. Terebinthinæ (specifically)
Ergota
Veratria (at last)
Colchicum
Senega (at last)
Physostigma (at last)
Opium (chiefly)
Ipecacuanha
Potassium
Lithium
Purgatives
Diuretics
Diaphoretics

Substances Stimulating Inhibitory Apparatus.

Digitalis (at first)
Scilla (at first)
Convallaria
Senega (at first)
Belladonna (briefly)
Stramonium ,,
Hyoscyamus ,,
Tabacum (at first)
? Ergota
Opium (briefly)
Plumbum (indirectly)

Substances Depressing Inhibitory Apparatus.

Amyl Nitris
Nitrite of Sodium
Nitro-glycerine
Spiritus Œtheris Nitrosi
Digitalis (at last)
Scilla (at last)
Senega (at last)
Belladonna (in ordinary doses)
Stramonium (in ordinary doses)
Hyoscyamus (in ordinary doses)
Tabacum (at last)
Chloral Hydrate
Opium (chiefly)

Substances which act upon the Circulatory System (*continued*).

General Vaso-Motor Stimulants.	General Vaso-Motor Depressants.	Local Circulatory Stimulants.	Reflex Cardiac Stimulants.
Digitalis (at first)	Amyl Nitris	Iodum	Alcohol
Scilla (at first)	Nitrite of Sodium	Camphora	Æther
Belladonna (briefly)	Nitro-glycerine	Arnica	Chloroformum
Stramonium (briefly)	Spiritus Ætheris Nitrosi	Alcohol (confined)	Sinapis
Hyoscyamus (briefly)	Digitalis (at last)	Æther (confined)	Ol. Terebinthinæ (reflex)
Strychnia	Scilla (at last)	Chloral Hydras	Ammonia
Alcohol (at first)	Belladonna (in ordinary doses)	Ol. Terebinth.	Carminatives
Æther (at first)	Stramonium (in ordinary doses)	Veratria	Counter-irritants
Chloroformum (at first)	Hyoscyamus (in ordinary doses)	Sinapis	Bitters
Acidum Hydrocyanic. (at first)	Lobelia	Cantharis	
Veratria (at first)	Tabacum	Ammonia	
Ammonia	Alcohol (at last)	Metallic Salts	
Plumbum	Æther (at last)	All Aromatic Volatile Oils, Oleo-resins, Resins, and Balsams.	
	Chloroformum	Acid. Carbolic.	
	Chloral (central and periph.)	Creasotum.	
	Acidum Hydrocy. (at last)		
	Veratria (at last)		
	Opium (moderately)		
	Antimonium		
	Ipecacuanha		
	Aconitum		

Reflex Vascular Stimulants.
Alcohol
Æther
Chloroformum
Sinapis
Ol. Terebinthinæ (reflex)
Ammonia
Carminatives
Bitters
Counter-irritants

Local Circulatory Depressants: Vascular Astringents.
Alcohol (evaporating)
Æther ,,
Chloroformum ,,
Plumbum
Argentum
Digitalis
Hamamelis
Constringents

Styptics.
Matica
Tannicum Acidum
Galla
Quercus
Krameria
Catechu
Hematoxylum.
Alumen
Ferrum

Substances lowering Blood Pressure in uncertain Manner.
Ergota
Physostigma (chiefly)
Barium

CHAPTER XI.

THE RESPIRATORY SYSTEM.

I. Physiological Relations.

The *red corpuscle* of the blood is the oxygenating or respiratory element of the body. The physical part of respiration is carried on by means of the chest and respiratory passages, a fresh supply of oxygen being continually presented to the red corpuscles, and carbonic acid, water, and heat given off from the plasma.

The red corpuscle and the chest are brought into functional relation with each other by means of a special nervous mechanism, called the *respiratory centre*, a portion of nervous matter in the medulla oblongata which is peculiarly irritable in the presence of oxygen, and sends motor impulses through the cord to the respiratory muscles.

The less the amount of oxygen admitted to the respiratory centre, the more powerfully is it stimulated, and the chest moved; the greater the amount of oxygen admitted to the centre, the less powerful its discharges, and the more weak or superficial is the breathing. Now the amount of oxygen in the arteries of the medulla is the same as in the systemic arteries generally; and we thus find that the state of oxygenation of the arterial blood governs the respiratory movements through the medium of the respiratory centre. The fundamental canon in the physiology of respiration is that *the condition of the red corpuscle is the prime mover of all respiratory acts.* Carbonic acid has no direct effect on the respiratory centre.

The term "centre" implies that certain influences meet in this point, originating in a circle of which it is the middle point; and this is the case. Falling into the respiratory centre are impressions conveyed by afferent—usually sensory—nerves, from every part of the body, modifying its activity, and reflexly influencing the respiratory movements. The vagus is peculiarly capable of stimulating the centre; thus irritation of the larynx immediately causes the reflex respiratory act called cough. The vagus is therefore said to be the special afferent nerve of respiration; the whole surface of the respiratory passages, and probably the lungs, being abundantly supplied with rootlets of the vagus, which are incessantly collecting impressions for transmission to the centre. Every change in the distension of the lungs, and in the quantity and quality of the pulmonary blood, thus instantly tells on the

respiratory movements. It must also be carefully noted in this connection that diminished oxygenation of the blood, whilst increasing the respiratory activity, stimulates the other two great centres in the medulla, increasing the arterial resistance through the vaso-motor centre, and slowing the heart through the cardiac centre.

The afferent impressions from the lungs and respiratory passages, besides falling into the respiratory centre, also reach, if sufficiently powerful, the convolutions, where they are felt as various *sensations*, referred more or less accurately to the respiratory organs. In health these sensations of common sensibility are feeble; and we do not appreciate them until they are converted into sensations of pain, oppression, distress, or irritation, in disorder or disease.

Amongst the nerves of the respiratory muscles one group demands special notice, viz. those distributed to the bronchi. These are motor filaments of the vagus, which originate in the respiratory centre and supply the muscles regulating the calibre of the air-tubes. They bring the bronchi under the control of the medulla, and thus of the afferent impressions, especially of those very impressions which originate in the respiratory passages, the seat of their own distribution.

II. Pharmacodynamics.

The extensive relations of the respiratory organs to the external air, to the blood and circulation, and to the nervous system, afford us abundant means of influencing their mode of action. These means we will now review in their natural physiological order:

1. *The Air.*—The air which comes in contact with the organs of respiration may be altered in five different respects, each of which will have a physiological effect upon the functions of the lungs, viz. as regards (*a*) its *absolute amount*, (*b*) its *chemical composition*, (*c*) its *temperature*, (*d*) its *moisture*, and (*e*) its *pressure*.

(*a*) The supply of air, like that of the food, may be entirely *arrested* for a time, another gas with different physiological properties, such as Nitrous Oxide, being allowed to take its place. Or the amount respired may be simply *reduced*, by administering rarefied air; or *increased*, by admitting oxygen or compressed air into the lungs. The same effects may be produced by ordering little or much muscular exercise respectively.

(*b*) The *chemical composition* of the atmosphere, physiologically speaking, relates only to the amount and quality of the

oxygen. The proportion of oxygen to nitrogen in the air may be modified by arrangements for special inhalation, but practically this is seldom attempted, mountain and ocean climates affording us a much more satisfactory supply of pure air.

(*c*) The *temperature* of the air respired may be modified either by selecting particular climates—tropical, sub-tropical, temperate, or cold; by artificial regulation of the atmosphere of the room—ventilation, heating, etc.—or by arrangements for warming or cooling the ingoing current of air only, by means of so-called "respirators," and by recommending nasal breathing only, or oral breathing only, as the case may be.

(*d*) The amount of *moisture* in the air respired can be altered at pleasure, whether by residence in a dry climate or in a moist climate, or by varying the amount of watery vapour in the air of the room, or in the individual inspiratory draughts, by means of steam kettles, hot-water inhalations, etc.

(*e*) Lastly, the *pressure* of the air is completely under our command; and this again either by means of climate (elevated mountain residence), or by local artificial arrangements such as the air-bath and pneumatic apparatus. The *compressed air-bath*, at a pressure of $\frac{1}{8}$ to $\frac{1}{4}$ of an atmosphere above the normal, increases the amount of oxygen admitted into the blood, as well as the vital capacity and the size of the lungs, whilst it renders respiration less frequent and more easy. A rarefied atmosphere is never given as a bath; on elevated mountains it increases the depth and frequency of respiration and the vascularity of the lungs, so that there is a tendency to hæmorrhage from the alveoli. The *pneumatic apparatus*, a small gasometer, admits air under artificial pressure to the respiratory passages only, the patient breathing into, or out of, a valved tube connected therewith. Inspiration of air compressed by about $\frac{1}{10}$ atmosphere increases the amount of air entering the chest, and eventually the vital capacity, the size of the chest, and the respiratory force, whilst it diminishes the vascularity of the lungs and raises the arterial pressure. The other methods of *aërotherapeutics* do not require mention here.

2. *The Red Corpuscle.*—The red corpuscle as the great medium of external and internal respiration, as well as the prime mover of the respiratory centre, is an important agent through which the respiratory activity may be modified by food, drugs, and all the ordinary natural influences, studied in chapter viii.

3. *The Circulation.*—The corpuscles must be circulated by the heart and vessels, and any effect that we may produce upon these will greatly modify the respiratory functions. The pharmacodynamics of the circulation are discussed in the preceding chapter.

4. *The Lungs and Air-passages.*—(*a*) *The afferent or sensory nerves* of the respiratory organs are *stimulated* by cold and dry air, Chlorine gas, Ipecacuanha, Senega, Tobacco, Nitre fumes, Ammonia, and Antimony. They are *depressed* or soothed by warm and moist air, warm food, warm applications to the chest wall; possibly by demulcent substances to a small extent; and by Opium, Chloral, Chloroform, and Ether. *Sensations* connected with the respiratory organs may be modified by the same means, the nerve-depressants thus proving to be pulmonary anæsthetics or anodynes, as well as interfering with reflex respiratory acts.

(*b*) *The vessels of the bronchi* may have the circulation through them *increased* by all measures which increase the activity of the circulation generally, viz. by purgation, exercise of the lungs, and bodily movement; by Digitalis, Scilla, Ammonia, Alcohol, Strychnia, and probably the whole series of Aromatic Oils to be presently noticed. *Per contra*, the bronchial circulation may be *depressed* by all cardiac and general vascular depressants, including heat, Alkalies, Iodides, Aconite, Antimony, and Ipecacuanha.

(*b'*) *The pulmonary circulation* bears very complex relations to the respiratory movements, as regards the pressure and rate of flow in inspiration and expiration, ordinary and extraordinary. Manifestly as regards the general circulation, the pulmonary vessels may be modified by every influence which affects it, such as blood-letting, transfusion, purgation, a variety of drugs, and muscular rest or exercise. We possess one substance, non-officinal, which specifically contracts the pulmonary vessels, namely Muscarin, the active principle of the mushroom.

(*c*) *Glands of the bronchi.*—The secretion of bronchial mucus may be *increased* by alkalies, especially Ammonia; by Iodine, Sulphur, and Antimony; by Ipecacuanha, Senega, Tobacco, Scilla, and the great group of Aromatic Volatile oils, Oleo-resins, and Balsams, including Turpentine, Camphor, Benzoin, Copaiba, Ammoniacum, and the balsams of Peru and Tolu. Warm liquid food remarkably increases the bronchial secretion; on the contrary, cold dry food *diminishes* the bronchial mucus, as possibly do Belladonna, Stramonium, and Hyoscyamus, and certainly acids.

(*d*) *The nervo-muscular structures* of the bronchi and larynx are *stimulated* by those measures which act upon the afferent nerves (*a*) and perhaps they are also directly influenced by some of the same.

A group of substances of great therapeutical interest directly *depress* the same system, and so relax the bronchial walls and

favour the movements of the respiratory air, viz. Belladonna, Stramonium, Hyoscyamus, Lobelia, and Tobacco; Opium, Chloral, and Cannabis Indica; Chloroform, Ether, Amyl-nitrite, and Iodide of Ethyl; Conium, and warm moist air.

5. Impressions reaching the respiratory centre through *other channels than the vagus* afford us a remarkably ready means of affecting it. Impressions may be *stimulating*, including irritation of the fifth cranial nerve in the nose by Ammonia, or on the brow by cold; of the olfactory nerve by odoriferous substances; of the optic and acoustic nerves by powerful light and sounds respectively; and of the nerves of the skin generally by painful impressions, such as flicking with towels, flagellation or slapping, extreme heat, mustard plasters, and other powerful local irritants. Or we may use measures with a *sedative* influence on the respiratory centre, including gentle warmth to the surface of the chest in the form of poultices and fomentations, warm baths, and local anæsthetics or anodynes, such as plasters and liniments of Opium, Belladonna, and Volatile Oils (Turpentine, Camphor, etc.) applied to the chest-walls.

6. *The Respiratory Centre.*—Besides those influencing the afferent impressions, a variety of direct stimulants and depressants of this centre are in our possession. The force of the nervous discharges may be *increased* by Ammonia, Strychnia, Belladonna, Stramonium, and Hyoscyamus; probably by Ipecacuanha and Antimony temporarily; and by Alcohol, Ether, and Chloroform, for a brief period at the commencement of their action. On the other hand, the last-named drugs quickly *diminish* the force of the respiratory centre (Ether less rapidly than the others); and the same effect may be produced by means of Chloral, Opium, Aconite, Veratria, Conium, and Physostigma.

7. *The Tracts of the efferent impulses from the respiratory centre, the Spinal Centres* of the respiratory muscles, and *the Nervo-muscular Apparatus* of the chest and larynx may be *stimulated*, not only reflexly, but directly, by Strychnia, which greatly increases the vigour of the spinal centres; by electricity applied to the nerve trunks (phrenics, intercostals), or to the muscles directly; and by all measures which improve the nutrition of the nervo-muscular tissues, such as well-ordered exercise. Conversely, these parts may be *depressed* by Physostigma, which greatly diminishes the vigour of the spinal centres; by Conium, which paralyses the motor nerves; and by Opium, which depresses the whole efferent mechanism. The use of these depressing measures is almost confined to the muscles of the larynx. Most powerful of all is the method of arresting, or at least controlling, the movements of the chest, by direct restraint, which is best accomplished by means of strapping or bandaging.

When we review the various measures classed under the 1st, 4th, 5th, 6th, and 7th preceding heads, we are enabled to re-arrange several of the most important of them into new groups with definite pharmacodynamical properties and important therapeutical bearings. These groups are—(A) *Expectorants;* (B) *Antispasmodics;* and (C) *Respiratory Sedatives.*

A. **Expectorants.**—Expectoration, the discharge of the sputa, or secretions and other products of the respiratory passages, will manifestly vary with the *amount* and *characters* of the sputa, and with the expulsive *force* which can be brought to bear upon them. Measures are therefore called *expectorants* which increase the absolute amount of sputum formed, which so modify its characters as to facilitate its expulsion, or which evacuate it with greater ease: the first and second kinds of expectorants acting upon the glands, the third kind upon the muscular structures. Regarded otherwise, the expectorants will be found sometimes to stimulate the respiratory centre, *e.g.* Ammonia and Ipecacuanha, sometimes to depress it, *e.g.* warm, moist air. But of greatest practical importance is the action of expectorants upon the circulation; and according to their stimulating or depressing influence in this respect, they are commonly divided into (1) *Stimulant expectorants*, and (2) *Sedative expectorants.* It must be clearly understood that "sedative" and "stimulant" in this connection refer *not* to the respiratory, but to the circulatory effect of the bronchial measures.

(*a*) **Stimulant expectorants** include Ammonia, Scilla, all the Volatile Aromatic oils, Oleo-resins, and Balsams enumerated above; Strychnia, Alcohol, Senega, warm liquid food, and moderate exercise of the body generally or of the chest.

(*b*) **Sedative expectorants** include Alkalies, Iodides, Antimony; Ipecacuanha, and Tobacco; warm, moist air; and warm, moist applications to the chest-walls.

If we wished to construct other groups of expectorants we might add:

(*c*) **Expectorants with a sedative effect on nerves.**—These are chiefly obtained by combining other expectorants with Opium, *e.g.* Scilla and Opium, Camphor and Opium, Ammonia and Opium, Ipecacuanha and Opium—all of which combinations are officinal, Antimony and Opium, etc. Warm drinks have the same effect.

(*d*) **Expectorants which alter the chemical composition of the sputa.**—This is a highly important group. Alkalies increase the alkalinity of the sputa, and at the same time the water of the bronchial mucus, and thus the liquidity of the sputa. They constitute a special class called the **Saline expectorants.** Sulphur, Iodine, all the Aromatic Oils, Oleo-resins, and Balsams,

are excreted, as such, or as their products, along with an increased flow of mucus; and most of these, especially the aromatic substances, have an antiseptic, deodorant, and disinfectant effect on the secretion, and on the surface from which they are given off. They may be classed as the **Disinfectant expectorants.** The water of the bronchial mucus is increased in almost every instance of increased secretion, but specially by Alkalies, Iodine, and Antimony, which thus possess the valuable property of increasing the liquidity of the sputa. Lastly, Acids tend to diminish the amount of water, and thus the total amount of sputum, *i.e.* to "dry up" the secretion. They may be called **anti-expectorants.**

B. **Anti-spasmodics.**—These comprise a great variety of measures which have the common effect, directly or indirectly, of relaxing the muscular coat of the bronchi and the diaphragm. They are: (α) the various depressants of the respiratory branches of the vagus mentioned above (4a), such as heat, Iodides, Alkalies, etc. (β) The depressants of the other afferent nerves to the respiratory centre (5), especially warm applications to the chest-walls. (γ) The depressants of the respiratory centre itself (6)—Alcohol, Ether, Chloroform, Opium, etc. (δ) The direct nervo-muscular depressants—bronchial (4 d), such as Atropia, Tobacco, Amyl-nitrite, etc.; and parietal (7), Conium, etc. All these substances are distinctly depressant or sedative; but we have still another group of bronchial antispasmodics (ϵ), which are perhaps the most powerful of all, viz. some of the expectorants, such as Ipecacuanha, Senega, and Tobacco, which after momentarily increasing the spasm, cause a rapid and profuse flow of mucus from the bronchial wall, thus relieving the fulness of the vessels, provoking cough, and inducing expulsion of the cause of the spasm.

C. **Respiratory sedatives.**—These measures deserve a special name. The depressants of the afferent branches of the vagus to the brain, such as Opium, Ether, Chloroform, etc., not only act as antispasmodics and muscular depressants, *i.e.* prevent bronchial spasm, widen the tubes, and arrest cough, but also prevent or relieve pain and other distressing sensations referred to the respiratory organs. The most rational kind of pulmonary sedatives, however, are the expectorants above enumerated, in cases where the cause of the distress can be removed. A combination of the two classes will manifestly answer best in most instances.

III. Pathological Relations.

The disorders and diseases of this system fall readily into two great classes, according as they affect (1) *the respiratory*

element (*the red corpuscle*) and *its circulation*, or (2) the *nervo-muscular apparatus*, including the lungs and air-passages, the respiratory centre, and the afferent and efferent channels of communication. The first class were discussed in chapters viii. and ix.; the second will now be briefly noticed.

Circulatory, inflammatory, and degenerative changes comprise a large part of the diseases of the respiratory organs, such as bronchitis, pulmonary congestion, emphysema, and pleurisy, to which must be added new growths, whilst tuberculosis and syphilis occupy an intermediate position. Whatever their pathological nature, these diseases produce certain well-marked anatomical changes in the parts. The passages may prove to be obstructed, or actually occluded, by swelling of their mucosa, and by various products, such as mucus, pus, blood, or *débris*, which may be retained, inspissated, or possibly decomposed, thus irritating the nerves and vessels. Some of the bronchia may be entirely blocked, with collapse or consolidation of the corresponding lobules, and disturbance of the air pressure (emphysema) and blood pressure (hyperæmia) in the parts around. Portions of the lungs may be found either consolidated by pneumonia, or compressed by pleurisy, airless and functionless. Tracts of various size are frequently entirely destroyed by phthisis or gangrene. Hæmorrhage may occur in the alveoli or passages. The right heart frequently proves to be secondarily enlarged, from disturbance of the venous circulation, the viscera congested, and the serous cavities and extremities dropsical.

Whilst many of these anatomical changes are fortunately remediable, others are not so, and the efforts of the practitioner can only be directed to the relief of their symptoms, or, more correctly, their effects. Amongst these, disturbances of respiration, spasm, cough, expectoration, vomiting, and pain, alone require to be briefly noticed here.

Dyspnœa is a natural effort to increase oxygenation, and is due to stimulation of the respiratory centre in two distinct ways, viz. (1) by the imperfectly oxygenated blood circulating within it, and (2) by exaggeration of the impressions coming from the air passages and lungs. Obviously these two sets of causes are usually combined, since such anatomical changes as have been mentioned, interfere at the same time with the proper contact of the air and blood in the lungs, and irritate the pulmonary branches of the vagus. As a rule, dyspnœa is successful and highly beneficial; but unfortunately, if it fail to give relief, it tends to aggravate the distress.

Spasmodic dyspnœa, commonly called "asthma," is referable to sudden intermittent irritation of the vagus or centre.

Powerful reflex respiratory impulses are thus generated, and pass out to the bronchial muscles and the diaphragm, which are spasmodically contracted, interfering with the entrance of air.

Cough is essentially a physiological act, in itself highly beneficial, which may require to be encouraged and increased. Much more commonly, however, it is excessive, and becomes one of the most distressing symptoms demanding relief in disease of the chest. *Expectoration* may also be considered physiological within certain limits, but will require to be modified therapeutically when the quantity of the sputa is either excessive or deficient, or the quality rendered morbid by inspissation or decomposition. *Vomiting* is closely associated with cough and expectoration, which is not a remarkable circumstance, the two acts and their mechanisms being nearly allied to each other, as we saw in chapter iv.

Pains, and sensations of irritation, tickling, necessity to cough, "want of breath," tightness, oppression, suffocation, etc., are always exceedingly distressing; and, as they are among the chief complaints of patients, demand relief if it can be afforded.

IV. Natural Recovery.

Nature's method of meeting an extraordinary or otherwise morbid influence by *destroying* or *removing* it, is well seen in the case of the respiratory system. Coughing and sneezing are provisions for expelling any obstructing or irritating mass from the air-passages; and although apparently but of little service in preventing the most serious kinds of lung disease, they may really expel infective and other causes of morbid change much more frequently than we suspect, just as they guard the nose and the glottis from mechanically irritant particles.

The second great natural method of relief which is seen at work in this system is *reaction* or *counter-action*. The respiratory muscles respond to an obstruction in the passages by such an increase of the force and frequency of their contraction as will negative its action, and after a time they become hypertrophied if the obstruction persist. Dyspnœa or (better) hyperpnœa, is the result, a large reserve of muscular force and an almost unlimited power of hypertrophy sufficiently *compensating* for the diminished size of the air-passages and air-current, by increasing the depth and the frequency of breathing. The same principle is at work in the catarrh, that is the hyperæmia and secretion, set up in the air-passages or lungs on the entrance of a foreign body; the mucous, serous, or even purulent discharge—all evidences of different degrees of reaction—being

essentially intended to counteract the irritant, as well as to carry it off and repair the damage it may have wrought.

The third natural provision against a morbid influence is the *removal of its effects*, whether the influence itself have been removed or antagonised, or not. Thus excessive secretions or other products of disease, which may in turn cause fresh obstruction of the passages, are removed by cough, expectoration, and vomiting; and the venosity of the blood which they cause is dispelled by hyperpnœa. Even spasm of the bronchi probably never causes death, because removed by the carbonic acid which accumulates in the blood in the second stage of asphyxia. Hæmorrhage from the lungs or nose frequently comes to the relief of over-distended veins, and removes the most urgent symptoms.

Vicarious action is yet another method of natural relief, of which abundant advantage is taken in respiratory disease; extraordinary muscles being called into play in hyperpnœa, the healthy parts of the pulmonary substance taking on increased function, and the skin and kidneys doubtless becoming more active as excretory organs.

In these several ways nature will frequently afford relief of respiratory disorders and diseases, whilst the cause of them is still at work, by removing or counteracting it and its effects. If she fail, and disease is established, recovery may still follow artificial treatment, the proper province of which is thus to assist, not to compel, much less to thwart nature. Even if organic changes have occurred, recovery may be effected by repair, as we see in inflammation of the lungs and pleura.

V. Rational Treatment.

The treatment of respiratory disorders if it is to be thoroughly rational, must be founded upon the considerations given in the four preceding sections. The student will understand that the treatment of the *disease* on which these disorders depend must be conducted at the same time; and that we are here concerned only with symptoms.

Dyspnœa.—The phenomena of dyspnœa strongly indicate the necessity of providing, by every possible means, for increased freedom and force of respiration—of assisting hyperpnœa by admitting as much air as possible into the chest. The air must be pure and mild, that is, abundant, fresh, warm, and moist. The muscles of respiration must be free to act upon the chest, and every available muscle of extraordinary respiration must be relieved from other employment and ready to be called into use: the shoulders must be raised, the chest freed from restraint and weight, in front, behind, and especially below (by

adopting the sitting posture), and the arms must be capable of being fixed, if necessary. The circulation also must be spared by absolute rest and other measures.

Medicinal treatment must then be ordered, the first end to be secured being the rapid clearance of the respiratory passages of the products of disease. This is done by stimulating the natural provisions for relief, namely *cough and expectoration*, by means of expectorants. The cough must not only be induced or strengthened, but accompanied by a more profuse flow of watery mucus, so as to facilitate discharge of the sputa. Fortunately, most expectorants produce the second effect as well as the first; and we are left free to select our remedy, more from a consideration of its concomitant effect upon the circulation, *i.e.* according as a *sedative* or a *stimulant* effect is desired. Cardio-vascular sedatives, such as Antimony, Ipecacuanha, Iodides, and Alkalies, or a combination of these, will be preferred as expectorants in the first stage of inflammatory obstruction of the passages (*acute bronchitis*), salines being specially valuable as liquefying the mucus; whilst stimulants, such as Ammonia, Scilla, and the large Aromatic group, will be indicated at a later stage when the heart threatens to fail, or at any period in weak subjects. The Aromatics, such as Camphor, the Balsams of Benzoin, Tolu and Peru, Ammoniacum and Turpentine, also act as disinfectants, if the products have become purulent and tend to decompose. In every instance the value of warm liquid food must be taken advantage of.

Emetics may be employed to empty the respiratory passages when blocked by a comparatively large and solid mass, such as a croupous membrane; to empty dilated bronchial tubes when these and the lung-tissue have lost their elasticity from age and debility; and occasionally, when the necessary cough can no longer be induced on account of extreme weakness, and asphyxia is threatening. In the last-named case much danger attends such a depressing method of treatment; and in every instance comparatively mild and yet certain emetics must be selected for respiratory purposes, such as Ipecacuanha and Carbonate of Ammonia, or Sulphate of Zinc if these fail.

Posture is frequently of value in emptying the bronchi, or cavities communicating with them, of pus and other products. The body may sometimes be even inverted with success.

If asphyxia occur, artificial respiration must be carried out.

Dyspnœa may also be relieved by the abstraction of blood, or by its diversion from the thorax into the abdominal vessels, where its volume can be reduced by a free purge. This sometimes affords great relief at the commencement of acute bronchitis. Diaphoretics and diuretics are valuable

under similar circumstances. But instead of reducing the volume of blood, or in addition to this means, we may prevent its accumulation in the lungs and right side of the heart by stimulant measures. Thus Carbonate of Ammonia not only irritates the nerves and glands of the bronchial mucosa, liquefies the secretion, and strengthens the respiratory centre, but is a powerful cardio-vascular stimulant, aiding the ventricular contractions, emptying the veins, and filling the arteries. Other circulatory stimulants which may not possess expectorant action are so far also indicated in respiratory distress, such as applications of mustard to the chest-wall and warm alcoholic drinks.

In dyspnœa from consolidation of the lung in acute pneumonia, *i.e.* from *diminished respiratory area*, the plan of treatment must be considerably modified. Here there is neither lack of air nor lack of blood; only they cannot come into mutual contact. The respiratory rate is greatly accelerated, and the air thus constantly changed; the cardiac rhythm is also accelerated, and the blood thus constantly renewed. The therapeutist appreciates this natural provision, and directs his measures to the support of the powers thus severely taxed: to maintain the strength of the respiratory muscles, and, most anxiously of all, to sustain the heart, by failure of which death is most likely to occur. Whilst, therefore, the strength is spared in every way, food is to be freely given with Alcohol, Scilla, Ammonia, and Digitalis; the atmosphere maintained as pure and fresh as possible; and the accompanying fever, which is attended by cardiac depression, steadily combated by suitable non-depressing measures.

Dyspnœa with spasm is so far to be treated on the same principles as other forms of obstructive dyspnœa, but the spasmodic element must be separately considered. Practically, by far the most rapid and powerful antispasmodics are, as we have seen, certain *expectorants*, including Tobacco, Ipecacuanha, etc., which provoke greater spasm, violent cough, and profuse watery secretion, thus instantly clearing the passages and relaxing the mucous membrane. A milder and equally rational class of antispasmodics to be employed in asthma are the direct depressants of the nervo-muscular structure of the bronchi, the chief of which are Belladonna, Hyoscyamus, Stramonium and their Alkaloids, Tobacco, and Lobelia, whether in solution or in the form of smoke. Conium is much less useful. Moist warm air or steam may be of great service as the only available remedy. Opium, Chloral, Cannabis Indica, and other narcotics, will frequently relieve spasm, but such powerful respiratory depressants are highly objectionable in

threatening asphyxia. Nitrite of Amyl may instantly give relief, but the spasm may as quickly return; Nitre fumes suit some cases. Small doses of Spirit of Ether or Chloroform in solution are frequently most valuable, because so rapidly diffusible; and a mixture of Ammonia, Carbonate of Ammonia, Spirit of Ether, and Aromatics is one of the best combinations for general use.

Cough has been already referred to as far as it is to be encouraged, for the relief of movable obstruction and dyspnœa. When it is not only ineffectual but harmful, for instance when due to swelling, morbid growths, or purely nervous causes, it demands immediate relief. It cannot, however, be too much insisted on that the tendency of young practitioners is towards an abuse of this class of remedies, by prescribing them in a routine fashion for every case of cough, irrespective of its cause. Narcotics are powerful depressants of the respiratory centre, as well as of many other organs, including the heart; and, which is of equal consequence, they interfere with the reflection which originates useful cough and increased breathing, and ultimately aggravate the condition which they temporarily relieve. It is only when the cause of cough cannot be removed, that the irritability of the nervo-muscular apparatus may be safely reduced by respiratory sedatives, such as Opium, Chloroform, Ether and Chloral, Alcohol and Conium, according to circumstances, although warm moist air, warm liquid food, poultices to the chest, and acids or demulcents for the throat will often suffice to give relief. Several of these measures may be topically employed by insufflation, inhalation, gargling, or direct application, and when given internally they are advantageously combined with expectorants, which shall remove any movable irritant from the passages. When all but powerful opiates have failed to arrest protracted fits of coughing, as in phthisis, frequent small meals of warm liquid nutritious food, night as well as day, or pure alcoholic stimulants, will often give great relief. When the sputa are excessive, anti-expectorant measures may be demanded, and will consist in a fresh bracing atmosphere, dry simple food, the avoidance of alcohol, and the exhibition of Acids, Bitters, and probably Iron internally.

Hæmorrhage from the respiratory organs must be treated on general principles. Rest must be secured not only by bodily quiet, but by the reduction of the movements of the lungs to a minimum, by strapping the chest locally and recommending voluntary restraint of respiration and cough.

Pain and the other forms of *distress* in connection with this system are easily arrested by direct respiratory sedatives, such

as Opium, but, as we have seen, not without considerable risk. The greatest discrimination must, therefore, be exercised in having recourse to these remedies, and the routine use of them is to be deprecated. Indirect measures, including the removal of the cause of distress, and external application to the chest, are alone to be employed if possible.

SUBSTANCES WHICH ACT UPON THE RESPIRATORY SYSTEM.

Stimulants of Respiratory Centre.	Stimulant (Circulatory) Expectorants.	Antiseptic Expectorants.	Respiratory Sedatives.
Camphora (at first)	Scilla	Iodum	Belladonna
Belladonna	Senega	Sulphur	Stramonium
Stramonium	Ammoniæ Carb.	Benzoinum	Hyoscyamus
Hyoscyamus	,, Liquor	Styrax	Oleum Terebinthinæ
Strychnia	Ammonii Chlor	Camphora	Cannabis Indica
Tabacum (briefly)	Strychnia	Cubeba	Quebracho
Quebracho	Alcohol	Oleum Terebinthinæ	Amyl Nitris
Acid. Hydrocyanic. (briefly)	All Aromatics	Eucalyptus	Acid. Hydrocyanicum
Physostigma (briefly)		Creasota	Æthyl Iodidum
Ammonia		Acidum Carbolicum	Opium
Alcohol (briefly)	Sedative (Circulatory) Expectorants.	Pix Liquida	
Æther ,,		Copaiba	
Chloroformum ,,		Balsam. Tolutanum	
Antimonium ,,	Antimonium	Balsam. Peruvianum	
Ipecacuanha ,,	Ipecacuanha	Myrrha	
	Apomorphia	Ammoniacum	
Depressants of Respiratory Centre.	Alkalies	Anisi Oleum	**Anti-spasmodics.**
	Iodides	And other Aromatic Oils	
Antimonium	Tabacum		Amyl Nitris
Bromides			Conium
Camphora (at last)			Potassii Iodidum
Belladonna (at last)	Saline Expectorants.		Belladonna
Stramonium ,,			Stramonium
Hyoscyamus ,,			Hyoscyamus
Lobelia			Lobelia
Tabacum (chiefly)			Tabacum
Chloral Hydras	Potassii Iodidum		Potassæ Nitras
Acid. Hydrocyanic. (chiefly)	Potassæ Bicarb.		Opium
Aconitum	,, Citras		Chloroformum
Physostigma	Sodæ Bicarb.		Æther.
Conium	Sodii Chloridum		
Opium			
Veratria			

	Anti-Expectorants.	
		Opium
		Acids
		Ferrum

CHAPTER XII.

THE NERVOUS SYSTEM.

The therapeutical relations of the nervous system are as extensive as those of the whole body itself. Pain, for example, is constantly associated with local disease, and many of the most distressing diseases of the viscera are disturbances of nervous mechanisms. Here we must confine ourselves chiefly to the therapeutical relations of the higher nervous centres, representing sensation, consciousness, and voluntary motion, especially to the means by which we may relieve pain in general, produce unconsciousness, and induce sleep. The student must also clearly understand that we are approaching the therapeutics of the nervous system from the *physiological* side, *i.e.* the treatment of symptoms only. The treatment of the *pathological* processes, such as hæmorrhage, degeneration, syphilis, which constitute these diseases and cause these symptoms, is another and even more important part of the management of this class of cases, and one which falls under other heads.

I. Physiological Relations.

Nervous tissue is a kind of protoplasm with highly specialised properties, which may be resolved into the one great property of displaying or discharging force when brought into contact with certain influences. We name this property *irritability;* the influence which calls it forth, *an irritant;* the act of calling it forth, *irritation*. If the effect be the display of more force than ordinary, we speak of the influence as a *stimulant*, and of the act or result as *stimulation*. If the effect of irritation be the display of less force than ordinary, we say there has been *depression*—that the influence is a *depressant*. Much discussion is still going on as to the nature of irritation, stimulation, and depression, but the points just indicated are clear enough for our present purpose.

Plan of the Nervous System.—The nervous system, though forming one continuous mass of nervous tissue, is built up of a number of *centres*, which are connected with an *irritable surface*, and with the *organs of force*. An impression made on the surface by an irritant is conveyed by an *afferent* nerve, or tract, to the centre; effects there some change upon the protoplasm; and either remains as potential energy, or flows out again through *efferent* tracts and nerves, as an *impulse*, to the organs of force—the muscles, glands, vessels, etc. This process is spoken of as *reflex action*. Nervous substance is, however, not simply

irritable, or capable of being brought into action by an impression from without. It can also *originate* action. It is *automatic* as well as reflective. The automatic action of the higher centres is the basis of the emotions, of the intellect, and of the will, and is continually modifying the impulses flowing out of the reflex centres, and *vice versa*, by means of connecting fibres or tracts. In the same way the viscera, such as the heart, are innervated by automatic centres in the medulla or cord, and these are constantly influenced by impressions reaching them from all sides. The highest centres are in the convolutions; the simple automatic reflex centres in the basal ganglia, cerebellum, medulla, and cord—the whole constituting a series of successive centres, the central nervous system, joined to each other by tracts which associate or co-ordinate the impulses, whilst the outlying systems of ganglia, chiefly automatic in their action, are called the *sympathetic*.

Now we find, when we come to consider the action of drugs and other remedies on the nervous system, that certain of them affect one centre, some another; some afferent parts, others efferent or motor parts; that some drugs affect the lower centres only some the centres of emotion and intelligence only; and that others again interfere chiefly with the co-ordinating mechanism. We must therefore attempt to arrange the parts of the nervous system on something like a definite plan, before we can comprehend the action of drugs upon it.

Plan of the Nervous System.

I. The terminal irritable apparatus, on the surfaces of the body, and in the organs.
II. The afferent nerves.
III. The posterior of cornua of the cord.
IV. The convolutions.
V. The basal ganglia and cerebellum.
VI. The medulla oblongata.
VII. The antero-lateral tracts and anterior cornua of the cord.
VIII. The co-ordinating fibres between the different centres, especially in the cord, where they form definite columns.

If we were to add to this plan, we might put in the viscera with their nerves. These we have relegated to other chapters; and all that need be indicated at present is that most of the viscera are governed by centres in the medulla, cord, or cerebrum, an arrangement which is partly reflex; that the efferent nerves between the centres and the viscera are intimately con-

nected with the sympathetic chain; and that the viscera have also intrinsic ganglia, by which their automatic action is chiefly carried on.

Sensation.—Sensation is a cerebral state, referable to an impression received through an afferent nerve. This generally originates at the periphery, more rarely in the afferent nerve or tract, but is in every case referred to the periphery. In this way an *impression* (peripheral) becomes a *sensation* (cerebral), and a sensation in turn may or may not travel onwards into a still higher part of the cerebrum, where it becomes a *perception*, a part of *consciousness*, a mental act. Of the various perceptions, common sensibility alone demands special notice here. The tissues and organs in health are sensitive, but not the seat of actual sensations. Very slight disturbance, however, is sufficient to arouse perception or consciousness of the condition of the organs, of which pain is an example, and we therefore assume the constant existence of a quiescent sense, called *common sensibility*.

Motion.—All movement may be said to originate as an *impulse* in a nervous centre, whence it is conveyed to muscles or muscular organs by *efferent* or motor nerves. Thus an impulse arising in the automatic action of the cerebral cells travels from the higher to the lower centres; here it joins the reflex impulse, proceeding by reflexion from these centres; and the mixed impulse courses through the motor nerves to a special *terminal apparatus*, say in a muscle, by which the motor nerve is brought into relation with the organ. Just as a perception in the cerebrum may be referable to a condition of any part of the afferent or sensory side of the nervous system, so muscular contraction may be produced by stimulation of any part of the efferent or motor side, from the convolutions to the muscle itself; and what is of special interest to the therapeutist, it frequently originates, wholly or in part, in stimulation of some part of the sensory side, reflected through the centres.

Consciousness.—This in a purely mental state, partly consisting of perceptions, and partly inseparably associated with the emotions, the intellect, and the will. Consciousness depends on the perfectness of the whole sensory apparatus, but from a practical point of view it may be considered to reside in the cerebral part of the same, *i.e.* in the convolutions, where it is readily reached by the therapeutist.

Sleep.—We cannot account perfectly for natural sleep, but we are probably right in associating it with diminished metabolism of grey matter, whether due to deficient blood supply, to impaired quality of blood, or to the molecular inactivity of

the tissues following exhaustion. Sleep bears a definite relation to work, food, and the time of the day, and brings rest and refreshment to the exhausted system.

II. Pharmacodynamics.

When we come to consider how far the nervous system is under our influence, we enter upon a field of enormous proportions, of which we can take but a few examples.

1. *Sensation.*—We have a remarkable power over both common sensibility and the special senses, increasing or diminishing their activity at our pleasure, by means respectively of *local stimulants* and *local anæsthetics.*

a. **Local stimulants.**—This name is given to a great and mixed group of agents, which increase common sensibility or common sensation so much as to cause *pain.* The majority of them act directly upon the *nerve fibrils* in the tissues, such as extreme heat, extreme cold (for a time), faradic electricity, and many drugs, including: Iodine and Bromine; Alcohol, Ether, and Chloroform, when the vapour is confined; Carbolic Acid and Creasote; volatile oils, *e.g.* Turpentine, Cajuput, Menthol, Thymol; acrid essential oils, *e.g.* Mustard and Mezereon, and Cantharides in the first stage. Mineral Acids and Ammonia; Metallic salts, such as those of Silver, Lead, Zinc, Antimony, Mercury, Arsenic, and Copper, also stimulate the nerves and cause severe pain, but not when supplied in sufficient strength to interfere markedly with the vessels and protoplasm of the part as caustics or astringents. Possibly some local stimulants act primarily upon the vessels, and many of them no doubt excite the circulation as well as the nerves. It must be carefully noted that the effect of local irritation on the sensory apparatus is really a *central* one. The sensation of pain, although it may be referred to the periphery, is a cerebral state. It therefore affords us a means of rousing the highest centres. What is even more important therapeutically, the whole of the impression conveyed from the irritated spot does not become converted into a painful sensation or act of consciousness. A portion of it, whilst traversing the grey matter of the spinal and medullary centres *en route*, disturbs these and causes reflex impulses, which rouse the muscles and viscera. In this way sensory, and especially *painful* impressions are powerful and readily available means of stimulating not only consciousness but the cardiac, vaso-motor, and respiratory centres, and through them the great viscera themselves. Thus the cold douche produces a sensation of cold referred to the part, rouses consciousness and so excites the respiratory

centre as to cause the gasping movements of breathing familiar under the circumstances. In other words, *local stimulants may become powerful general stimulants.*

b. **Local Anæsthetics.**—Pursuing an exactly opposite line of action, we can readily diminish the sensibility of the origins of nerves until their power of receiving impressions is lost, and thus remove sensations by preventing the very contact of the influence with the nervous system. The measures which have this effect are called **local anæsthetics** (*ἀν, without*, and *αἴσθησις*, sensibility), or if pain be relieved, **local anodynes** (*ἀν, without*, and *ὀδύνη, pain*). Some of these agents directly depress the nerve fibrils, such as Belladonna, Aconite, Veratria, and Opium; and Ether, Alcohol, Chloroform, Carbolic Acid, Volatile Oils, and Cantharides, when their application is prolonged. Moderate cold, especially such as is induced by evaporation, is decidedly anæsthetic; and Ether, Spirits, Acetic Acid, Water, and various Saline solutions, *e.g.* of Chloride of Ammonium, possess this property. Prolonged or extreme cold directly reduces the functions of the nerves, causing first numbness, and then absolute anæsthesia. Warmth reduces, and extreme heat destroys, the irritability of the nerves. Other anodynes act partly or wholly through the vessels. Thus moderate heat relieves pain partly by dilating and relieving the blood vessels, and by increasing the blood-supply, the osmosis, and the migration of corpuscles in the tissues—an effect which is assisted by moisture, as familiarly seen in poultices. Cold partly acts by reducing excessive blood supply. The galvanic form of electricity often removes pain very quickly, probably by acting on the nerves, muscles, vessels, and even the metabolism of the part.

The influence of local anæsthetics and anodynes is not confined to the sensorium. With the arrest of sensation, the whole brain passes into a state of rest, and sleep readily occurs. The in-travelling impressions being reduced in strength, the spinal and medullary centres through which they pass, or into which they previously radiated, are no longer excited, and the action of the organs, such as the lungs and heart, becomes more automatic, and, as a rule, but not invariably, more quiet. Thus, as with local irritants, we possess in local anæsthetics and anodynes, a powerful means of influencing the functions of the highest centres, the visceral centres, and the viscera themselves. In other words, *local sedatives may become powerful general sedatives.*

c. All these measures act upon the peripheral structures. The *trunks* of the afferent nerves may also be affected so as to interfere with the convection of the impressions. Opium, and

possibly other drugs, heat and cold, electricity, properly regulated pressure, and section or stretching of the nerves are different means of removing sensibility or at least pain.

d. The sensitive and perceptive *centres* in the cerebrum may be the seat of action of anæsthetics. Amongst the substances possessing this effect are Opium, Chloral, Chloroform, Ether, and Cannabis Indica, consciousness as a whole being affected by these measures, which are called **general anæsthetics**, **general anodynes**, or **narcotics**—a series of titles which will be presently noticed. Lastly, it will be observed that certain substances, such as Opium, arrest the afferent impressions *at every point*—at their formation, in the course of their conduction, and where they impinge upon the sensorium, that is, they act upon the sensory tract from one extremity to the other.

e. The special senses also can be directly influenced by various measures, including drugs. Local anæsthetics reduce the keenness of the sense of touch. Deafness and subjective noises are produced by Quinia, Salicylic Acid, and Alcohol. Santonin causes green vision. Taste is excited by a variety of influences which we have already studied; depressed and peculiarly disturbed by Aconite and other alkaloids.

2. *Motion.*—Our command of the motor side of the nervous system is greater than our influence over sensation, for the reason that motor parts can be acted on not only directly, but also reflexly through sensory parts, as we have just seen—local irritants exciting muscular movements, and local depressants arresting them.

a. Motor stimulants are specially interesting, as different drugs act on different parts of the motor apparatus from the cerebrum to the muscles. Alcohol, in moderate doses, increases the activity of the "motor" *convolutions*, and so probably do Chloroform and Ether for a very short time. *The medulla*, as the centre of the respiratory movements, is excited by Strychnia, Ammonia, Belladonna, and by small doses of Alcohol, Ether, and Chloroform. The *anterior cornua* of the cord (probably in association with the posterior cornua) are powerfully stimulated by Strychnia—convulsions being readily induced. Stimulation of the *motor nerve-trunks* can be used to excite the muscles by means of faradaic electricity.

Our most valuable motor stimulants, however, are applied to the *terminations* of the nerves, the *terminal apparatus*, and the *muscles* themselves, in the form of **local motor stimulants.** Strychnia acts also in this way. Electricity is in constant use for this purpose—as the faradaic, occasionally as the galvanic, current. Passive movements of the limbs, rubbing, shampooing, and douching, by rousing the local circulation and

metabolism, are also means of preserving or increasing muscular nutrition and activity.

b. Motor depressants are a parallel series of agents. The motor convolutions are disturbed, depressed, and finally completely "paralysed" by large doses of Alcohol, Chloroform, and Ether, which completely arrest all voluntary movements. The motor functions of the *medulla* are so powerfully depressed by Opium, Chloral, Aconite, Conium, Physostigma and large doses of Alcohol and Chloroform, that death from poisoning by these substances occurs in this way. The *anterior cornua* of the cord are depressed by Physostigma and many less powerful drugs, which cause paralysis of the limbs through this channel. The same effect is produced by Conium and other substances, through depression of the *motor nerves*, not of the cord. The *motor nerve-endings* are remarkably under the influence of Belladonna; more, however, those of the involuntary muscles, with which we are not at present concerned. Galvanism is the most powerful local depressant of muscular activity, and is our ordinary means of producing this effect directly.

c. The *co-ordination of movement* is peculiarly interfered with by certain drugs, at any rate by Alcohol, which in considerable doses produces staggering gait, disturbance of the ocular muscles with double vision, thickness of speech, and awkwardness of the manual movements.

3. *Consciousness.*—From the very exalted position which it occupies in the system, consciousness is peculiarly amenable to a variety of influences at our command.

a. It can be *roused* by powerful, especially by painful impressions: for instance, the cold bath or douche; heat, or hot applications such as mustard to the surface; loud sounds, or powerful odours. Besides these, many drugs directly excite the brain, the **cerebral stimulants and deliriants**, such as Caffein, Camphor, Alcohol and Chloroform in the first stage; Opium, Chloral, and Cannabis Indica, in some individuals; Belladonna and its allies; Camphor, Salicylic Acid; laughing gas, etc.

The mental faculties are readily *disordered* by many of the same measures which increase consciousness, leading to laughing, crying, brilliancy of the imagination, increase of the appetites, confusion of the intellect, loss of control of the will, delirium in its many forms, and even convulsions. Alcohol, Opium, Cannabis Indica, Chloral, Chloroform, Camphor, and Belladonna, are specially active in producing these effects, which are seldom or never desired by the therapeutist for their own sake.

b. Equally valuable are our means of *reducing* consciousness, *or removing* it, and thus producing general anæsthesia,

which, in appearance at least, closely resembles sleep, and is associated with suspension of all the other mental faculties. This effect may be secured by temporarily arresting the functions of the convolutions by means of drugs which *directly depress the nervous tissue of the convolutions*, such as Chloroform, Ether, Bichloride of Methylene, Alcohol in large doses, Chloral, and Opium. The Bromides, Caffein and Zinc, are valuable **cerebral depressants**, as they diminish reflex excitability, and thus promote rest of the nervous centres. Beyond these, a number of powerful substances, such as Aconite, and other vegetable and mineral poisons, produce a condition of coma with unconsciousness. The question arises, Which of the many active substances which possess this power are convenient and suitable for use? Careful observation has taught us that the *order of involvement of the various parts of the nervous system* by these substances—the line of march of their phenomena—differs widely with the different drugs. With some of them, such as Ether and Chloroform, the very first phenomenon is disturbance of the convolutions; and it is not until consciousness has been completely removed, that any serious depression of the medulla and its vital functions occurs. With others, for example, Opium and Chloral, the cerebrum and medulla appear to be simultaneously and equally involved; and before consciousness has been completely removed, the centres of respiration and circulation in the medulla may be dangerously depressed. A third set of nervous depressants have hopelessly paralysed the medulla before consciousness is much disturbed; such are Aconite and the irritant poisons. In selecting for use a drug which will remove consciousness, we entirely reject the third set. The first set, with Ether and Chloroform as their types, we retain as our **general anæsthetics**; the second set, including chiefly Opium and Chloral, are used under special circumstances, and are generally called **narcotics** (*νάρκη*, a deep sleep), or, as we have already seen, *anodynes*, pain destroyers.

The action of **narcotics** is very complex, extending from one extremity of the sensory side of the nervous system to the other, influencing also its motor side, and disturbing the sensory, motor, and metabolic functions of most of the viscera. In a person under the full influence of Opium, an impression can only be made with difficulty upon the peripheral nerves, or on the organs of sense; it is slowly and imperfectly conducted; and it is imperfectly perceived in the cerebrum. Thus cut off from all but the most powerful external impressions, and itself reduced in activity, the cerebrum is practically in the condition of deep sleep, characterised by unconsciousness. A fact of much greater importance, since unconsciousness is not of itself

serious, however prolonged, is that it is accompanied by great depression of the medulla, that is, of the respiration and circulation, which, although sometimes to be turned to useful account, may readily prove injurious or even highly dangerous. We thus possess in narcotics a powerful means (1) of arresting perception, (2) of inducing sleep, and (3) of soothing the great vital functions, all of which may be of the greatest therapeutical service.

4. *Sleep.*—We possess many methods of promoting or producing sleep, which we call **hypnotics** (ὕπνος, sleep), or less properly "narcotics." Thus we may be able to secure mental calm, or the absence of noise and light, and to prevent or relieve pain or other disturbing impressions, such as attend indigestion, heart disease, and cough. Along with these *indirect hypnotics*, we may employ *direct hypnotics*, which act on the convolutions, either through the circulation or immediately upon the cells, in either way reducing nervous metabolism. Amongst medicinal hypnotics, the purest are perhaps the Bromides, which appear to bring the brain into a condition which favours the advent of natural sleep, rather than to induce it artificially, if any such distinction can be drawn. Artificial sleep is readily induced by the narcotics proper, including Chloral, Opium, and Alcohol, as well as general anæsthetics, all of which produce hypnotism amongst their other effects, and may be used for this purpose.

III. Pathological Relations.

We will now briefly consider some of the most common and typical disturbances of the nervous system. The organic diseases of this system are of great variety, including morbid states of the vessels, syphilis, degenerations, etc., but it is only the principal symptoms to which they give rise that will be noticed here for the purpose of illustrating the applications of the measures just discussed.

1. *Disturbances of Sensation: Pain.*—Pain is a familiar disturbance of common sensibility of a peculiarly distressing kind. As an expression of disease, whatever the tissue affected, pain always originates in some nervous structure between and including the periphery and the convolutions, but in every instance it is referred to the periphery. When pain is severe, it is accompanied by certain other phenomena, such as mental depression and restlessness, sleeplessness, weakening of the heart, indigestion, and other visceral disturbances. These may be in part effects of the morbid condition on which the pain also depends, but it is to be observed that pain is in itself a powerful depressant of the centres and viscera, just like local depressants of a pharmacodynamical nature.

2. *Paralysis.*—Loss of power, may be taken as an instructive illustration of motor disturbance. Comparably with pain, paralysis depends on injury or disease, of whatever nature, in some part of the motor side of the nervous system—the convolutions, basal ganglia, medulla, lateral column and other motor tracts, the anterior root of the spinal nerve, the nerve trunk, or the terminal motor apparatus in the muscle; occasionally it is distinctly a reflex effect of sensory disturbance; but the paralysis is always seen in the muscle. No class of disease teaches us more clearly the dependence of rational therapeutics upon an accurate knowledge of the anatomy, physiology, and pathology of the parts affected.

3. Side by side with pain and paralysis respectively, there are to be ranged many allied conditions. Thus, allied to pain, and depending like it on disturbance of some part of the *sensory* tract, are the sensations of numbness, coldness, excessive sensibility to touch (hyperæsthesia), excessive sensibility to painful impressions, such as pin-prick (hyperalgesia), and the various disturbances of the special senses; loss of the sense of touch (anæsthesia), loss of the sense of pain (analgesia), and alteration or loss of the organic sensations relating to the stomach, bowels, heart, bladder, etc. In the same way we place beside paralysis other motor disturbances, whether in the form of increased muscular movements—chorea (St. Vitus's dance), tremors, spasms, convulsions, or disturbed movements of the viscera, as of the heart, intestines, uterus, vessel walls, etc.; and we say that they may be due to disease of any part of the motor tract from one extremity to the other, or of some part of the sensory area of the nervous system by reflection through the centres. Reflex spasms, convulsions, and visceral disorders, are especially common.

4. Disturbances of *consciousness*, and of the other higher faculties of the nervous system, include unconsciousness or insensibility, delirium or excitement, and the great class of "diseases of the mind" constituting insanity. Unconsciousness may be the result of injuries to the head; of interference with the blood-supply to the brain, familiarly seen in fainting; of interference with the supply of air to the brain, as in asphyxia; or of poisons, such as alcohol and opium. To these causes we may add organic diseases of the brain, and indeed most diseases just before death. Delirium and other forms of excitement are phenomena of many diseases, and of the action of a variety of poisons, and must be regarded as associated, both as effects and causes, with excessive nervous metabolism, leading rapidly to exhaustion.

5. *Sleep* is most commonly *deficient or absent* when it calls for

treatment; very frequently disturbed; sometimes excessive. Pain is the common cause of insomnia, but sleep may be prevented or broken by cerebral exhaustion (? vascular paralysis) from overwork, by mental anxiety or distress, by oppressed or breathless feelings in the chest, by dyspeptic troubles, and by other distressing sensations, such as irritability of the bladder, spasms of the muscles, and itching of the skin. Sometimes sleeplessness appears to be idiopathic, *i.e.* a disorder *per se*. Excessive *sleepiness*, or continual tendency to sleep, is a result of the retention and circulation in the system of urea or allied products which have not been sufficiently excreted by diseased kidneys; and drowsiness, to a less degree, is a frequent symptom of anæmia, or of disturbed metabolism in the liver, as we saw in the tenth and eleventh chapters. Certain articles of diet, especially alcohol in the form of beer, produce the same effect.

IV. Natural Recovery.

As the nervous system is the most impressionable of all the tissues, so it seems to possess the power of recovery most quickly and most perfectly from conditions of disorder, when the causes of these are removed. Thus, pain may instantly disappear upon a slight change of temperature, on the application of a weak electrical current, with the alteration of the chemical reaction of the part, or in consequence of the contact with it of a minute quantity of some drug—any of which means will have sufficiently restored its normal condition, or counteracted the abnormal state which gave rise to the distress. In no department of pathology, therefore, is the indication clearer, and encouragement greater, to step in and assist nature by pharmacodynamical measures. Unfortunately, here, as elsewhere, there are certain *limits* to treatment. The disorders of the nervous system to which we have alluded, such as paralysis, spasm, pain, anæsthesia, and disturbances of consciousness and of the mind generally, are too often but the phenomena or symptoms of organic disease of the delicate nervous structures. Scarcely less hopeless is the prospect of curing certain functional disorders of the nervous system, without discoverable anatomical cause, such as epilepsy and hysteria. But even in both these classes of cases, many of the most urgent symptoms, and the severity and frequency of others, can be mitigated by the measures which we have just reviewed, as we shall now attempt to show.

V. Therapeutics.

In drawing a rational conclusion from what we have studied under the four preceding heads, we approach, as we proposed,

the consideration of the therapeutics of the nervous system chiefly from the point of view of symptoms.

1. *Disturbances of Sensation: Pain, and the use of Anodynes.*—Our review of the physiological and pathological relations of pain leads us to its rational treatment. We must discover, first, its morbid cause, and secondly its exact physiological significance, and apply our measures accordingly.

The scientific use of anodynes, as we have already suggested, is founded upon correct diagnosis. It will frequently be found that when the cause is known, pain can be removed without the employment of any nervine remedy, and in every instance this treatment should be entertained or attempted. An abscess will be relieved by the knife, headache by purgation, syphilitic periostitis by Iodides. We thus discover a great group of measures which, whilst they are not anæsthetics, are *indirect anodynes*, because they attack the pathological cause of the pain, and do not immediately act upon nervous tissue. *For practical purposes*, anodynes may be classified into (1) *indirect anodynes;* (2) *direct anodynes which act on the peripheral nerves only;* and (3) *direct anodynes which act on the centres as well as the periphery.* In many instances these may be combined.

a. Indirect anodynes are necessarily a heterogeneous group, and include surgical operations of every kind, which are amongst the readiest and most radical of all, *e.g.* opening abscesses, simple physical protectives, such as ointments and oils in burns; poultices and warm fomentations, and cold in various forms.

Local irritants, such as mustard and blistering agents, which cause much pain at first, may become local anodynes by producing an effect which is called *counter-irritation.* We shall discuss fully this class of remedies in chapter xv., but we may for the present refer their action to exhaustion of the irritability and conductivity of the local nerves, to dilatation of the vessels and relief of anæmia, and to some influence on the nervous centres corresponding to the affected part. Another powerful natural group of local anodynes, which are chiefly indirect, but partly also direct, in their action, consists of the essential oils, such as Turpentine, Camphor, and the Oils of Cloves, Mint, etc. These have a complex action: they destroy the organisms of disease by virtue of being antiseptic; they dilate the vessels, causing redness and heat; and they depress the peripheral nerves after temporary pain. Certain allied artificial products possess a similar indirect and direct anodyne power, *e.g.* Carbolic Acid and Creasote. Besides these *local* indirect anodynes, we possess an unlimited number which act *generally*; as many, indeed, as the remediable causes of pain. Thus, headaches may

be relieved, under different circumstances, by any of the local measures just enumerated, or by such diverse general remedies as purgatives, Quinia, Iron, Iodides, and Alcohol, quite independently of the direct anodynes which we may consider it necessary to apply.

b. Local Anodynes.—When treatment directed to the cause of the pain fails or is insufficient, we must next attempt to reduce the irritability of the nerves by local means. Direct *local anodynes* may now be rationally employed. Thus in neuralgia, constitutional treatment must be combined with the application of a local anodyne sufficiently powerful to interfere with the reception and conduction of impressions. We therefore employ Aconite, Belladonna, Opium, the confined vapour of Chloroform, Alcohol, or Ether, the Volatile Oils, Carbolic Acid, Creasote, heat (which must often be extreme), extreme cold, the continuous current, or local nervous irritants. Most of the drugs mentioned are applied in the form of liniments, lotions, or ointments. Opium may be administered by the endermic or hypodermic method, the former being now almost entirely superseded by the latter, which is by far the most valuable of all anodyne measures, from the readiness with which it can be given, and the rapidity and completeness of its action. Alcohol or Chloroform may be poured on lint, and evaporation prevented, or rubbed on the part and covered.

c. General Anodynes.—When pain is very severe, sleep impossible, and the whole system distressed and disordered, direct general anodynes are demanded. The most useful is Opium or Morphia, which may be given in a great variety of forms, and by several channels, the most ready and powerful of all being the hypodermic method. Chloral, Butyl-chloral, and Cannabis Indica, are other general anodynes in use, but are greatly inferior to opium. The narcotic or hypnotic effect of these anodynes is taken advantage of, as a rule, by prescribing them at the usual hour of sleep.

Where the pain is unbearable, and relief must be not only complete but instant, even these powerful anodynes may be unavailing. In such cases *general anæsthetics* must be employed: the patient must be put under the influence of Chloroform or Ether. Such are the pains of labour, or of the passage of calculus, the pain attending the reduction of a dislocation or a severe surgical operation. Consciousness is quickly abolished, kept in abeyance, and allowed to return when the cause of the pain has ceased. The necessity for such powerful remedies in some instances of pain will impress on the student the importance of sparing the nervous system, and the viscera which are reflexly depressed along with it, in every case of pain.

Food and stimulants are, as a rule, urgently indicated in protracted pain.

2. *Loss of Common Sensibility.*—Neither this nor the allied condition of loss of touch (*anæsthesia*) very often calls for treatment, and the large number of nerve irritants which we possess in the Acids, Metallic Salts, Mustard, etc., are seldom used for this purpose. Pyrethrum is sometimes given in anæsthesia of the mouth.

3. *Paralysis.*—The rational treatment of paralysis will depend entirely on its nature, and the seat of its cause; and this, as in the case of pain, must be ascertained as accurately as possible. If the lesion be cerebral, general remedies must be directed to relieve the pathological state, such as Mercury in syphilis, cardiac measures in vascular rupture, and so on. Rest of the mind, *e.g.* by Bromides, will be all important. There is no indication, as a rule, to increase the activity of the damaged centres, except after a time by the use of the will; on the contrary, all cerebral stimulants, such as alcohol, are better to be avoided. In paralysis from disease of the cord, the same general system of treatment is to be followed, but Strychnia may be tried as a direct stimulant of the affected part, sometimes with success. In paralysis due to injury or disease of the nerve trunks or peripheral nerves, the cause must be carefully searched for and if possible removed, *e.g.* tumours. The local injection of Strychnia appears to benefit some cases. In every kind of paralysis, local treatment must be carried on along with general, and consists chiefly in exercise of the terminal nerves and muscles by electricity, friction, and passive movements, with the view of sustaining the local circulation and nutrition until the centres shall have been restored.

4. *Excessive Motor Activity*—in the form of spasm, tremors, and convulsions—being generally due to peripheral irritation reflected through the centres, is rationally treated by removal of the cause. The convulsions of children, for instance, are generally to be treated by stomachics and purgatives; the spasms of adults by carminatives. But in many cases it may be necessary also to employ remedies which depress the reflective centres, such as the Bromides and Opium. When the cerebrum is believed to be the seat of disorder or disease attended by these symptoms, *e.g.* epilepsy, the Bromides are of great service, whilst tetanus, hydrophobia, and other spasmodic diseases with better defined organic causes in the cord and medulla, may be rationally treated by Physostigma and Chloral. It cannot be said, however, that much success rewards such treatment, possibly because employed, as a rule, too late. When the spasm appears to be due to purely local

causes, Belladonna and Conium are often of use, *e.g.* in chordee, spasmodic asthma, and laryngismus. The continuous battery current and counter-irritants relieve painful spasm of the voluntary muscles. Lastly, Opium again is a most powerful antispasmodic for general use.

5. *Consciousness* may be said to demand temporary *removal*, in anticipation of the excessive pain and anxiety attending operations. The general anæsthetics in common use are Ether and Chloroform, the selection and use of which are fully described under their special therapeutics. Conditions of *excitement*, such as delirium and mania, are to be met by two sets of remedies, which must always be combined—viz. first, cerebral depressants, such as Opium, Chloral, Hyoscyamus, Bromides, and, if necessary, Chloroform; and secondly, general nutrients and stimulants, chiefly in the form of abundant food, and possibly a certain amount of alcohol. Judicious moral treatment is an indispensable accompaniment.

6. *Loss of consciousness* appears to require and receive treatment in cases of fainting, drowning, accidents to the head, etc., but the great centres of respiration and circulation are the real objects of our anxiety. They have been depressed along with the convolutions, and must be restored to activity if life is to be preserved. Restorative measures include the re-establishment of the general and cerebral circulation by the recumbent posture and cardiac stimulants, and of respiration by artificial chest movements and abundance of fresh air. Local nervous irritants such as cold affusion, flagellation, or mustard applied to sensitive parts, powerful odours, and Ammonia, must each or all be employed.

7. *Disorders of Sleep* will be rationally treated by pursuing the course suggested by our previous considerations. *Insomnia* may be met by the many indirect and direct hypnotics. In every instance full advantage must be taken of the indirect group. Bromides are indicated when the cerebral circulation is excited by overwork ; and Chloral may be combined with it. When pain is present Opium only will induce sleep. When there is much mental distress Opium is again necessary, and Alcohol at bedtime may be invaluable. In every instance the time of administration of hypnotics must be carefully ordered. Further, it must never be forgotten that the narcotics, including Opium, Morphia, and Chloral, are all powerful depressants of the respiration, circulation, and excretions, and may produce disastrous results, whilst they afford the temporary advantage of sleep.

SUBSTANCES WHICH ACT ON THE NERVOUS SYSTEM.

LOCAL STIMULANTS.

Alcohol
Æther
Chloroformum
Ammonia (at first)
Acid. Carbolic. (at first)
Creasotum (at first)
Oleum Terebinthinæ
Veratria (at first)
Cantharis (at first)
Potassa Caustica
Argenti Nitras
Plumbum
Zinci Chloridum
Hydrargyrum (at first)
Iodum (at first)
Bromum
Arsenicum
Antimonium
All Aromatic Oils
„ Oleo-resins
„ Resins
„ Balsams
Acrid Oils.
Mineral Acids.

LOCAL ANÆSTHETICS; LOCAL ANODYNES.

Belladonna
Stramonium
Hyoscyamus
(?) Conium
Bromides
Opium
Alcohol
Chloroformum (chiefly)
Acid. Carbolic. (at last)
Creasotum (at last)
Acid. Hydrocyanic. Dil.
Sodæ Bicarb.
Creta
Aconitum
Ol. Terebinthinæ
Pix
Veratria (at last.
Cantharis
Zinci Oxidi (at last)
Iodum (at last)
Local Refrigerants.

LOCAL ANÆSTHETICS; LOCAL ANODYNES (continued).

Bismuthum
All Aromatic Oils.
„ Oleo-resins
„ Resins
„ Balsams

CEREBRAL STIMULANTS AND DELIRANTS.

Belladonna (at first)
Stramonium („)
Hyoscyamus („)
Tabacum
Santoninum
Camphora
Alcohol (at first)
Chloroformum (briefly)
Coffee (at first)
Guarana „
Theobroma „
Cannabis Ind. (at first)
Lupulus (at first)
Opium (at first)

CEREBRAL DEPRESSANTS.

Bromides
Acid. Hydrocyanic. Dil.
Coffee (at last)
Tea (at last)
Guarana
Theobroma
Ol. Terebinthinæ
Potassium
Lithium
(?) Argentum
(?) Cuprum
Zincum
Arsenicum (?)
Antimonium

HYPNOTICS.

Bromides
Narcotics
General Anæsthetics.

SUBSTANCES WHICH ACT ON THE NERVOUS SYSTEM (*continued*).

NARCOTICS.	STIMULANTS OF MOTOR CENTRES OF CORD.	DEPRESSANTS OF MOTOR CENTRES OF CORD (*continued*).	DEPRESSANTS OF MOTOR NERVES AND NERVE ENDINGS.
Opium (at last) Chloral Hydras Belladonna (at last) Stramonium Hyoscyamus Alcohol (at last) Cannabis Ind. (at last) Lupulus (at last)	Nux Vomica and Strychnia Chloroformum (at first) Æther (at first) Ergota (at first) Opium (briefly) Ammonia	Gelsemium Opium (at last) Potassium Lithium (?) Argentum (?) Cuprum Zincum (?) Arsenicum	Conium Belladonna Stramonium Hyoscyamus Amyl Nitris Acid. Hydrocyanic. Dil. Opium
GENERAL ANÆSTHETICS.	DEPRESSANTS OF MOTOR CENTRES OF CORD.	STIMULANTS OF MOTOR NERVE ENDINGS.	REFLEX MOTOR STIMULANTS.
Nitrous Oxide Chloroformum Æther Bichlor. of Methylene Dichlor. of Ethidene Æthyl Bromidum	Physostigma Camphora Bromides Alcohol Chloroformum (at last) Æther (at last) Amyl Nitris Sodii Nitris Ergota (at last)	Strychnia and Nux Vom. Opium (briefly)	Strychnia Counter-irritants Carminatives Ammonia

CHAPTER XIII.

THE KIDNEY.

The position which the kidney occupies in the circle of the great physiological systems gives a special character to its diseases, and to the actions and uses of remedies in connection with it. The series of vital processes which commences with the admission of food, air, and medicines, ends chiefly with the excretion of urine. Digestion, assimilation, sanguification, metabolism, circulation, and respiration, all, therefore, affect the activity of the kidney. This is chiefly due to the fact that the kidney does not itself form the urea, uric acid, pigments, salts, and water which form the bulk of the urine —that these bodies reach it by the blood, and it has but to sweep them from the circulation. This dependent position of the kidney is of great interest to the practical therapeutist. Clinically, the condition of the urine is a key to the manner in which the various viscera are discharging their functions; pathologically, we often find in other organs the cause of renal disease; and pharmacologically, we discover that if we wish to affect the composition of the urine and the activity of the kidney, we must, in many cases, direct our measures to the digestive organs, the heart and the vessels.

Conversely, the kidney makes its influence felt backwards upon the other organs. Disturbance of the renal function quickly tells upon the blood and viscera. We saw this under the heads of the liver and metabolism, and noted how quickly the retention of waste products checked functional activity, like ashes choking out a fire. As striking a relation exists between the kidney and the organs of circulation. Thus the practitioner, adopting the inverse order of investigation, estimates the condition of the kidney by the pulse, bowels, and appetite; the pathologist finds in the enlarged heart and ruptured vessels of the brain the outcome of disease of the renal glomeruli; and the pharmacologist relieves the blood pressure or the liver by measures directed to the kidneys. These preliminary considerations will prepare us for the systematic discussion of this complex subject.

I. Physiological Relations.

The source of the urine is believed to be certainly double. The bulk of the *water* is excreted in the Malpighian bodies, being squeezed from the glomerulus into the capsule by the blood pressure within the former. The excreting force is determined (1) by the pressure of the blood entering the

glomerulus by the afferent vessel, and (2) by the resistance to its flow through the efferent vessel; whilst the freedom of filtration depends upon the fact that the uriniferous tubules have a free outlet, and thus present but little obstruction to the entry of water into their channel.

The size of the renal vessels is regulated by vaso-motor nerves, coming chiefly from the splanchnics, which derive their renal fibres from the medulla oblongata, in part at least through the first thoracic ganglion. The spot in the fourth ventricle which thus presides over the vessels of the kidney is a *centre, i.e.* it receives impressions through afferent nerves, and sends impulses through efferent nerves to the kidneys. Thus powerful emotions will disturb the flow of urine, and the temperature of the surface of the body affects the amount of urine secreted, partly at least reflexly.

The *solid constituents* of the urine—urea, uric acid, and their allies, and many of the salts, dissolved of course in a small quantity of water—are probably separated from the blood by the cells of the convoluted tubules. The activity of the renal epithelium no doubt depends, like that of the salivary glands, upon an inherent secreting force of its own, probably controlled by trophic nerves; upon the activity of the circulation; and especially upon the quality of the blood. We have already seen that the materials which the blood conveys to the kidney for excretion will depend upon the activity of all the bodily functions, and we will not return to this subject except with respect to *the influence of digestion and assimilation on the urine.* During gastric digestion a quantity of acid is withdrawn from the blood to furnish the gastric juice, and this loss of acidity in a fluid already alkaline makes itself felt in the urine, which soon becomes less acid, or even alkaline. This reaction increases when absorption begins. Water and salts enter the blood; augment still further the alkalinity of the urine, the salts being chiefly alkaline, and the total volume of the blood, and thus of the renal secretion, is increased; the arterial pressure rises. Finally, the products of the action of the liver, lungs, and other metabolic organs, upon the peptones and carbohydrates (urea and its allies) also enter the blood and appear in the urine, in comparative excess. This condition of the urinary function and urine, consequent on a full meal, gradually declines. The excess of water escapes; the alkaline salts are voided; the excess of urea and uric acid disappears; and therewith the general characters of the urine change. By the end of three or four hours from the admission of food, the urine is again moderate in amount, more acid, and clear, an increase of acidity following the previous reduction.

II. Pharmacodynamics.

The preceding considerations prepare us for the conclusion that what power we may possess over the excretion of urine will be exercised, as far as its water is concerned, chiefly through the circulation; as far as the solids are concerned, chiefly through the blood. These points must be separately studied.

1. *Measures for Increasing the Volume of Urine.*—The amount of water, that is, the volume of urine which is excreted from the glomerulus, may be increased by **diuretics**, the effect being called *diuresis* (διὰ through and οὖρον the urine). This may be accomplished in various ways:

(*a*) *By raising the pressure in the arteries generally, including the renal,* whilst the pressure in the veins is constant. This is most easily effected by temporarily increasing the amount of water in the system by drinking; by raising the force or the frequency of the heart, or both, by Alcohol, Digitalis, Scilla, Ammonia, and Scoparium; or by constricting the peripheral vessels through the vasomotor system, *e.g.* by cold to the surface, Digitalis, Scilla, or other vascular stimulants. These measures are called **cardio-vascular diuretics.**

(*b*) *By dilating the renal arteries,* so that the quantity of blood within them is increased, whilst the pressure in the arterial system generally, and the resistance in the renal veins, remain unchanged. This method of increasing the amount of the renal water may be carried out by acting on the vaso-motor system of the kidney either locally or centrally. Local depressants of the renal nerves include Digitalis and Scilla in the second stage; Spirit of Nitrous Ether; all Volatile Oils and Resins, such as Turpentine, Juniper, Copaiba, Hops, Savin, Cantharides, Camphor, etc.; Alcohol, Belladonna, Aconite, Nitrates, and Nitrites. Central renal vascular depressants are chiefly or solely emotional impressions which are not available as pharmacodynamical means. A powerful reflex dilator of the renal vessels is cold to the surface. Such measures are **local vascular diuretics.**

(*c*) *By combining the two previous means,* when still more profuse diuresis will be the result. This occurs in the second stage of the action of Digitalis and Scilla, and in the application of cold to the surface.

2. *Measures for Diminishing the Volume of Urine.*—The volume of urine might be diminished by employing the opposite set of influences to those just described. These are obscure, however, and of less therapeutical interest; and the student may be left to work out the different systems for himself.

3. *Measures affecting the Secretion of Urinary Solids.*—The

activity of the *renal epithelium*, *i.e.* the excretion of solids and of a certain amount of the water, may be modified by influences of two classes:

(*a*) *By measures and conditions which affect the renal cells through the composition of the blood in general.*—Of these, the state of digestion, including the selection of food, is the most important. The quantity of food; its richness in proteids, carbohydrates, and salts of different kinds; the relative amount of work thrown upon gastric or acid, and duodenal or alkaline digestion; and the vigour of hepatic metabolism, as determined by so many causes, including exercise, oxygenation, and the use of drugs—may all be made use of by the pharmacologist in altering the composition of the urinary solids.

One of the most easy and important of these alterations is in the *chemical reaction* of the urine. The natural acidity of the urine can be *increased* by excess of proteids, sugar, and starch, by deficiency of water, by certain wines and spirits, by Salicylic and Benzoic Acids, and by an excess of Tartaric and Citric Acids. The mineral acids have an insignificant or even negative power on the acidity of the urine, a fact which is to be carefully noted. Sulphuric Acid is excreted by the kidneys (in part), but as neutral sulphates; Hydrochloric Acid as neutral chlorides, Phosphoric Acid as phosphates; Nitric Acid is believed to increase the ammonia in the urine by decomposition in the blood, so that it may have an alkaline influence; and Tartaric, Citric, and Acetic Acids in combination with Alkaline bases, escape as Alkaline Carbonates.

On the other hand, we possess abundant and powerful means of rendering the urine *alkaline*. Amongst foods, the most effective in this direction are fruits, milk, and fish, as they throw into the blood a quantity of Alkaline Citrates, Tartrates, Acetates, Carbonates, and Phosphates, which are directly or indirectly excreted by the kidneys. Amongst drugs, the whole group of Alkalies and Alkaline Earths have an alkalinising effect on the urine, excepting Ammonia, which is completely broken up in the system. Thus the alkalies are entirely unlike the mineral acids in exercising a powerful and available influence on the reaction of the urine.

(*b*) *By measures which affect the renal epithelium specifically.* Whatever may be their alkalinising value in the blood, certain substances have a special influence on the urine by *specifically acting upon* the renal cells. Thus Potash and Soda possess equal values as alkalinisers of the *blood*, but potash will much more powerfully and quickly neutralise the acidity of the *urine*, because whilst Soda is excreted partly by the bile and bronchial mucus, or locked up in the system as the neutral chloride of sodium, Potash stimulates the renal epithelium, which

excretes it as the carbonate. Soda does, however, possess a degree of specific action on the kidney, especially its Phosphate and Acetate. Lithia closely resembles Potash in this respect; Ammonia, although not an alkaliniser, has a similar influence; and Magnesia and Lime are distinctly stimulants of the renal epithelium, as is well seen in some natural mineral waters. Now, in passing through the cells, these salts necessarily carry with them a certain amount of water from the venous plexus around the tubules, and if abundant, actually produce diuresis. They thus furnish us with another group of diuretic measures, which we call the **saline diuretics**, chiefly alkaline in their influence on the blood and urine, but at the same time independently active as specific renal stimulants. Let it be carefully noted that the saline diuretics do not, as far as we know, directly affect the renal circulation; but that we possess in them an indirect means of influencing the venous plexus around the tubules, and thus the whole renal circulation and the general blood pressure, especially the pressure in the veins.

Another great group of natural substances in the materia medica have a specific effect on the renal epithelium, namely, the Aromatic Oils, Oleo-resins, and Balsams. The chief of these are Turpentine, Juniper, Copaiba, Cubebs, Cantharides, and Hops; whilst Jaborandi, Alcohol, Aconite, and many more act partly in the same way. All these substances, either as such or after decomposition, are excreted (in part) by the renal cells, and carry with them, like salines, so much water, besides dilating the renal vessels, as we have already seen. The degree in which the different members of this great class act upon the renal cells varies widely, however: thus, Juniper and Copaiba are powerful diuretics, greatly increasing the urinary flow, whilst most of the others have but little effect on the volume of urine, possibly because their action on the renal vessels, which accompanies their action on the cells, does not favour the escape of fluid. Thus Turpentine and Cantharides, two most powerful renal stimulants, sometimes diminish, sometimes increase, the urinary water, and may even cause hæmorrhage from the glomerulus.

Opposed to these renal stimulants are *renal sedatives or depressants*, which appear to diminish directly the activity of the renal cells, when they reach them through the blood. Morphia has this effect, and possibly quinia (?) and other substances.

III. Pathological Relations.

The disorders of the renal functions, which will be taken by

us to illustrate the application of the measures just noticed, may be summarised as follows:

1. *Disorders of the fluid secretion referable to the general blood pressure.*—(*a*) *Diminution of the general arterial pressure*, which is generally referable to heart disease, leads to marked disturbance of the urinary flow. We saw under the head of the circulation (page 472) how dilatation of the heart lowers the pressure in the arteries and raises it in the veins, *i.e.* lowers it in the afferent vessel of the glomerulus, and raises it in the efferent vessel, thus causing *congestion of the kidneys*. The urine in this class of cases contains albumen and blood proceeding from the engorged veins; it falls in quantity in consequence of the fall in the arterial pressure, and of obstruction in the tubules, which become choked with fibrinous casts; and the total excretion of solids is diminished, as the result of retardation of the blood current.

(*b*) *Increase of the general arterial pressure* is associated with that form of chronic disease of the kidney known as the "Granular or Contracted Kidney." Here the urine is very abundant, probably reaching several times its normal volume, very light in colour and weight, and may contain a trace of albumen. The tension of the radial artery is high; the left ventricle is hypertrophied; and the patient often dies of secondary dilatation of the heart, or of rupture of an artery in the brain. As far as the kidney is concerned, the condition is one of constant pathological diuresis.

2. *Disorders of the fluid secretion, referable to the local blood pressure.*—(*a*) *Certain nervous conditions* disturb the pressure in the kidney by causing contraction or dilatation of the renal vessels, and thus modifying the amount of urinary water. Such a condition may be either central or local, direct or reflex. Thus hysteria is attended by alternately profuse and deficient flow of urine. Disease of the medulla and its neighbourhood may give rise to profuse diuresis (*diabetes insipidus*), which has been traced in other cases to disease of the renal nerves. Reflexly, the chief cause of disturbance of the renal secretion is injury or disease of the prostate or urethra, which may even lead to fatal suppression.

b. Morbid conditions of the blood-vessels of the kidney, such as disease of the glomeruli, arteries and veins, which constitute one of the elements of Bright's disease, produce a variety of disturbances in the volume and constitution of the urine, according to their exact seat and degree. Pressure on the trunks of the renal vessels by abdominal enlargements may also cause serious disturbance of the renal circulation, with albuminuria, hæmorrhage, or even suppression of urine as the result.

3. *Disease of the secreting epithelium.*—This constitutes another element of Bright's disease. The diseased cells fail in function, choke up the tubules, press upon the venous plexus, and thus give rise at once to stagnation of the blood current and resistance to the filtration of water through the glomerulus. The clinical phenomena of this condition (commonly called the Large White Kidney), are very definite. The urine falls in volume; the solids are absolutely diminished, but relatively increased, so that the specific gravity is high; and in their place there appear albumen, probably derived directly from the venous plexus, blood from the same source or from the glomeruli, and casts formed of diseased cells, fibrin, etc. The blood becomes poisoned by retention of urea. The systemic vessels become diseased, and the heart hypertrophied; and the blood-change and cardio-vascular disease together lead to marked breathlessness, and to escape of the watery parts of the blood into the tissues and serous cavities, constituting renal dropsy.

4. *Rise of pressure within the uriniferous tubules* is a serious cause of complete arrest of the secretion. This is one of the effects of fulness of the venous plexus, and of epithelial accumulations in the tubes, already noticed; and may also originate in obstruction of the ureter, disease or injury of the bladder and prostate, or stricture of the urethra.

5. *The condition of the blood.*—This is the most common of all the causes of derangement of the urinary secretion. A number of the disorders of the urine, as regards its reaction and relative composition, can be traced to dyspepsia, hepatic derangement, and defective oxygenation or metabolism; and even albumen, sugar, and bile may find their way into the urine from the same causes. One striking disorder of the urine is characterised by unnatural alkalinity and by its effects in precipitating the solid constituents. The urine is turbid from precipitation of phosphates, carbonates, and urates; and these are deposited in the passages, causing pain and irritation. If the natural acidity of the urine between meals be insufficient to dissolve these alkaline deposits, concretions are formed, and grow at each period of indigestion, until they form a *calculus*, which may travel downwards and be expelled with the urine after great suffering.

A similar disorder of the urine is characterised by excessive acidity. This has different causal relations, but the ultimate effects are practically the same—the precipitation of uric acid and urates, and possibly the formation of calculus. Excessive acidity is chiefly met with in the subjects of disorder of the liver from indulgence in proteid food (*see* page 443); and may be accompanied by an excess of urea, diminution of water, and occasionally by traces of albumen and sugar.

IV. Natural Recovery.

So many of the disorders of the urine are but expressions of derangement of the blood and of the great organic functions, that it is hardly necessary to say that natural recovery constantly occurs. Conversely, improvement in the condition of the urine is an evidence of the spontaneous return of the stomach, intestines, liver, heart, etc., to the normal state when the causes of their disorder have been removed.

The kidney possesses several provisions for natural recovery. It meets increased work by increased action; compensatory hypertrophy of one kidney occurs if the other kidney fail; and a close vicarious relation exists between the kidney and the skin and bowels. The practical therapeutist closely follows these natural methods in arranging his treatment.

V. Therapeutics.

A careful consideration of the four preceding sections specially impresses two facts upon us. First, the rational treatment of any case of renal or urinary disorders must be founded upon an appreciation of the influences of other organs upon the kidneys; and, secondly, treatment may be as often directed to the kidneys for diseases of other organs as when they are themselves at fault: diuretics will be as frequently employed to relieve the heart as to stimulate the cells of the kidney.

1. (*a*) *Renal congestion from heart disease.*—This may be taken as the type of renal disorder from diminished blood-pressure, whatever its cause; and such being the pathology of the condition, the line of rational treatment is obvious. To remove the cause we must restore the normal relations of the general circulation, that is, strengthen the heart, fill and keep full the arteries, and empty the veins. How this is to be done has been already discussed in chapter x., and need not be repeated here. We are now able to estimate the value of two sets of diuretic remedies which are successfully employed in such cases, namely, the *cardio-vascular diuretics*, and the *saline diuretics*. Digitalis and Squill exactly fulfil the indications just mentioned as regards the heart, the arteries, and the veins. They increase the cardiac vigour and the period of rest; sustain the arterial tension at a moderate height; and empty the veins forwards by prolonging the diastole. At the same time, partly by these effects and partly by their local action on the renal vessels, they cause a true diuresis from the Malpighian bodies, and increase the force of the circulation through the renal veins. Ammonia, Alcohol, or Scoparium, may be combined with these drugs; and here it may be remarked, once for

all, that combination is peculiarly useful in diuretics. Saline purgatives also assist this action. Thus Sulphates of Soda and Magnesia, Acid Tartrate of Potash, Tartrate of Soda and Potash, Acetate of Potash, Citrate of Potash or Ammonia, are, in the first place, saline purgatives, thus relieving general venous congestion; and, secondly, act upon the renal epithelium, draining the over-distended venous plexus, and accelerating the circulation through the glomerulus. In other instances dilators of the renal vessels may be combined with these remedies, including Juniper and Spirit of Nitrous Ether.

(*b*) *Disorder or disease of the kidney in association with excessive blood pressure; Bright's disease with contracted kidney.*—In the early stages of this disease, when its cause may be discovered in indulgence in food and alcohol, or disorder of the liver, the treatment consists in a thorough reform of diet, free purgation, and elimination generally. Mercurial purgatives followed by salines are especially valuable. In the more advanced and grave form of high arterial tension, the cause is usually beyond our power. All that can then be done is to counteract the cause, remove its evil effects, and treat symptoms. The food should be moderate in quantity, and chiefly non-nitrogenous; stimulants must be avoided; moderate rest of body and mind insured; and various drugs administered. We are unfortunate in possessing but few medicinal means of reducing peripheral resistance for any length of time without depressing the heart; but the Iodide, Chlorate, Nitrate, and other salts of Potash, Nitrite of Soda, Belladonna, and its allies may be tried. Warmth is very essential in these cases.

2. (*a*) *Urinary derangements from nervous disorder or disease.*—The treatment employed here must be entirely directed to the nervous system. Bromide of Potassium, Valerian, and other anti-spasmodics, including moral treatment, will relieve hysterical diuresis; and Opium and Ergot are successful in many cases of polyuria of obscure and probably nervous origin.

(*b*) *Local vascular disease.*—If the emulgent veins are obstructed by abdominal enlargement, this must be immediately removed, if possible—by tapping the peritoneum, for example, or by inducing premature labour. In disease of the renal vessels we can do but little by way of direct treatment beyond relieving symptoms as they arise; regulating the flow of urine as well as possible, especially stimulating it if it threaten to become deficient; and removing the excrementitious products by the bowels and skin, when the specific gravity falls.

3. *Disease of the tubules; "Acute Desquamative Nephritis,"*

"*Large White Kidney.*"—This is the form of kidney disease in which there is the greatest or most constant danger of deficient excretion, and of the consequences of the same throughout the system. The indications for treatment are obvious. We must relieve the diseased cells of as much work as can be safely dispensed with by the blood and tissues. The rational methods of relieving the renal epithelium are: (1) by reducing the food in quality and richness; and (2) by diverting the excrementitious products to other channels. Hydragogue purgatives are especially valuable in this form of Bright's disease; and the warm air or vapour or water bath, warm drinks, and Jaborandi, will successfully relieve the kidneys by perspiration. Renal stimulants, such as the saline and specific diuretics, might, on the other hand, exhaust the cells, already weakened by disease; but in certain cases they are highly useful even in this condition, for they may exert that amount of stimulation on the renal cells which, on the principle of alteratives in general, will lead to their restoration. If we believe that the tubules are blocked by cellular and inflammatory products, we must clear them by a system of flushing, or diuresis. For this purpose Distilled Water is the best diuretic; Digitalis and Squill are also valuable, as producing but little local irritation, and tending to prevent venous congestion.

In this or in any other form of renal disease, urgent symptoms of uræmia must be quickly relieved by venesection, the administration of Chloroform, free purgation, and, if possible, profuse diaphoresis. The anæmia generally demands Iron in some form.

4. *Obstruction in the urinary passages.*—The most common cause of this serious disease, namely, stricture of the urethra, is fortunately accessible, and amenable to surgical treatment. When the obstruction is above the bladder it is very rarely bilateral, and the unaffected kidney takes on the double function of the two.

5. *Disorders of the blood, liver, and digestion; Gravel and Calculus.*—The immediate treatment of these secondary disorders of the liver, in their early stage, has been already suggested: careful low dieting, and the occasional administration of cholagogue purgatives, stomachics, and antacids. If gravel or calculus have actually formed, several other measures are still open to us, whilst the same line of treatment is persevered in to prevent further growth. We may attempt to dissolve the stone *in situ* by the continuous admistration of Citrate of Potash, or of acids, as the nature of the calculus demands, and relieve pain, hæmorrhage, mucous and purulent discharges on general principles.

A. MEASURES WHICH ACT UPON THE RENAL CIRCULATION.

MEASURES WHICH INCREASE THE VOLUME OF URINE THROUGH THE CIRCULATION: CARDIO-VASCULAR DIURETICS.

RAISE GENERAL BLOOD PRESSURE.

Aqua Destill.
Alcohol
Digitalis (1st stage)
Scilla ,,
Convallaria
Ammonia
Scoparium (?)
Senega

DILATE RENAL ARTERIES.

Digitalis (2nd stage)
Scilla ,,
Alcohol ,,
Spiritus Ætheris Nitrosi
Volatile Oils
Resins
Oleo-Resins
Balsams
Salicylates
Nitrates
Nitrites

RAISE GENERAL PRESSURE AND DILATE RENAL ARTERIES.

Digitalis
Scilla

MEASURES WHICH DIMINISH THE VOLUME OF URINE THROUGH GENERAL CIRCULATION.

Opium
Ergota

B. MEASURES WHICH ACT UPON THE RENAL CELLS.

MEASURES WHICH ACT UPON THE RENAL CELLS THROUGH THE BLOOD IN GENERAL.

URINARY ALKALINISERS.

Potassium
Sodium
Lithium
Calcium
Magnesium

URINARY ACIDULATORS.

Acid. Salicylic.
,, Benzoic.
,, Citric.
,, Tartaric.
Mineral Acids

TONIC DIURETICS.

Stomachics
Hæmatinics

MEASURES WHICH ACT SPECIFICALLY UPON THE RENAL CELLS: GLANDULAR DIURETICS.

SALINE DIURETICS.

Potassæ Acetas
,, Nitras
,, Citras
,, Tartras
,, ,, Acida
,, Bicarb.
,, Carbonas
,, Sulphas
Sodæ Bicarbonas
,, Acetas
,, Citro-Tartras
Soda Tartarata
Ammonii Chloridum
Ammoniæ Acetatis Liquor
Ammoniæ Citratis Liquor
Lithiæ Carbonas
,, Citras
Lime Salts in Mineral Waters

SPECIFIC RENAL STIMULANTS.

Juniperus
Copaiba
Ol. Terebinth.
Sabina
Piper
Cubeba
Salicylates
Caffein
Uva Ursi
Pareira
Buchu
Arnica
Aconitum
Scoparium
Guaiacum
Cambogia
Cantharis
Volatile Oils
Oleo-Resins
Resins
Balsams
Jaborandi
Lobelia
Dulcamara
Alcohol

RENAL ALTERATIVES.

Iodum
Hydrargyrum

RENAL DEPRESSANTS

Morphia

URINARY (VESICAL) SEDATIVES AND ANTI-SPASMODICS.

Opium
Belladonna
Hyoscyamus
Stramonium
Uva Ursi
Buchu
Pareira

CHAPTER XIV.

THE BODY HEAT, AND ITS REGULATION: THE SKIN.

I. Physiological Relations.

Heat is *produced* in every act of vital energy; is *distributed* throughout the body; and is finally *lost* in the surrounding medium. In so-called "cold-blooded" animals, the vital heat is lost as rapidly as it is produced; in "warm-blooded" animals the heat produced does not escape until a certain amount has *accumulated* within the system. Thereupon loss sets in, and exactly balances the production, whilst the accumulated store remains constant, and is known as the "body heat," amounting, in man, to 98·4 degrees.

So wide is the range, so sudden are the changes, of the external temperature to which man is exposed, and so variable the amount of heat produced in the system at different moments, that in the course of its evolution the body has come to possess a complex and sensitive nervous mechanism, by which its temperature is controlled. This mechanism consists of governing centres, afferent nerves from impressionable parts, and efferent nerves to active organs. *The afferent thermal nerves*, originating in the skin, and possibly in other parts of the body, such as the mucous membranes and viscera, carry impressions of temperature (heat and cold) to the brain and cord. There these impressions are specially received by three of the great centres, viz. the *cerebrum*, where they become *sensations of temperature;* the *sweat centres* in the cord and medulla; and the *metabolic or trophic* centres, the centres of nutrition, in the brain (? pons) and cord. They also fall into the vaso-motor, cardiac, respiratory, and possibly the renal and other visceral centres. *Efferent impulses* from the sweat centres proceed to the sudoriparous glands, which they stimulate or depress, as the case may be; from the metabolic centres they are directed to the various sources of heat production—the muscles, glands, etc., which they depress or stimulate. At the same time, the circulation through the skin is modified, as well as the blood pressure generally, the respiration, renal secretion, and probably every other bodily function in some degree.

Thus, when the temperature of the air rises, the regulative mechanism comes into action, and two great effects are produced: (1) there is *increased loss of heat* by the perspiration, by cooling of the blood in the dilated cutaneous vessels, and by cooling of the blood in the lungs; and (2) there is *diminished production of heat* in the muscles, glands, etc. The same effect

follows a rise of the internal temperature due to increased metabolic activity, such as muscular exercise: a "warm glow" is felt, the skin flushes and perspires, the circulation and respiration are increased, and the activity of other metabolic organs, such as the liver, is for the time lowered. The skin is the principal channel of loss of heat in man; but during and after exertion a large amount of heat must be carried off by respiration, which is familiarly known to be the chief means of refrigeration in the dog.

Conversely, if the temperature of the surface be *lowered* by cooling of the atmosphere, two reflex effects are at once produced through the nervous system, viz.: (1) *diminished loss* of heat, by contraction of the vessels of the skin, by arrest of perspiration, and by reduced activity of the circulation and lungs; and (2) *increased production* of heat in the metabolic organs, especially the muscular, digestive, and circulatory. A similar result follows lowering of the internal temperature by diminished metabolism in some of the organs. Thus Quinia and Salicylic Acid, whilst they diminish the amount of the urea and therefore probably of the heat produced in the system, make little or no impression on the temperature of a healthy man, doubtless because the channels of loss are partially closed, and the metabolism of certain organs increased, by the regulating mechanism.

II. Pharmacodynamics.

1. *Temperature of the External Media.*—This is completely under our control. The atmosphere is the ordinary external medium of loss or gain of the bodily temperature, and the air of every well-constructed room or ward can be warmed or cooled at pleasure. We may select the *climate* in various ways, according to its temperature; the sub-tropics, such as Madeira, Egypt, and the Riviera, being especially valuable as affording warm climates. When a more rapid and extreme influence of the external temperature is desired, *water* may be substituted for air, in the form of baths, wet-packs, and sponging. The varieties, action, and uses of water applied in these several ways are described in the next chapter. By means of the *prolonged cold* bath, at a temperature varying between 32° and 60° Fahr., heat may be readily abstracted from the body; and the cold wet pack, cold affusion, or sponging a part or the whole of the exposed skin with cold or even tepid water, has a similar effect. These measures are known as **external refrigerants**. Heat may be *locally* abstracted by similar means, which will also have a general effect in reducing the temperature of the body. Thus, cold water may be injected into the rectum or vagina; ice or wet compresses applied to the skin; ice or cold water swallowed; or

irrigation with cold water may be used over a part. The cooling that attends evaporation is a powerful means of reducing the local temperature; and a variety of saline, spirituous, and acid solutions, such as Carbonate or Chloride of Ammonium, Spirit and Water, Brandy and Water, Vinegar and Water, or various combinations of salts, acids, and spirits, may be employed for this purpose.

2. *The Cutaneous Circulation.*—This affords us a powerful means of abstracting the body heat, inasmuch as we can modify the fulness of the vessels and the rate of flow through them. Thus we may cool the blood by dilating the cutaneous vessels by the warm bath, by Alcohol, Spirit of Nitrous Ether, or warm draughts, or by these measures combined. Opium and Chloral have the same effect. If the blood-flow be accelerated through the dilated vessels, the refrigeration is increased, and in this way cardiac stimulants of every kind, such as Alcohol and Digitalis, reduce the body temperature. Draughts of water, whether cold or hot, temporarily distend the vessels, and produce a similar effect. The opposite methods for preserving the heat of the body, by contracting the superficial vessels and reducing the activity of the cutaneous circulation, are of no therapeutical interest.

3. *The Sweat-glands: Diaphoretics, Sudorifics, Anhidrotics.*—The function of perspiration is under our control in almost every portion of its complex mechanism.

a. Measures which increase the amount of perspiration are called **diaphoretics** or **sudorifics.** The *afferent thermic nerves* in the skin can be readily stimulated by means of heat, as described in chapter xv., whether by moist heat in the form of the warm water- or vapour-bath, or various kinds of pack; by dry heat, as in the Turkish bath; or by general warmth of the air, of the room, or of the clothing. The familiar effect of Alcohol in inducing perspiration appears to be chiefly produced in the same way. *Other afferent nerves* may be used to stimulate the sweat-centres reflexly, such as those of the mouth throat, and stomach by hot spiced drinks. Perspiration may be induced by acting on the *perspiratory centre* directly. This may be accomplished by measures which increase the venosity of the blood, such as narcotics, including Opium, Chloral, Chloroform, Ether, and Alcohol in the later stages of their action; by Nicotin (Tobacco), by Pilocarpin (Jaborandi) in part; and by all measures which increase the flow of warm blood through the sweat-centres, such as hot drinks. The *efferent nerve-trunks* of perspiration may be stimulated by electricity, but this method is not therapeutically employed. The *terminations* of *the nerves* in the sweat-glands and the

secreting cells can be powerfully stimulated by Pilocarpin, which causes an exceedingly profuse and rapid flow of sweat. Diaphoresis will be favoured by a free supply of blood to the glands, *i.e.* by *dilating the vessels*, as just described. A number of substances induce diaphoresis without their mode of action being clearly understood, such as — Citrate of Ammonia, and especially Acetate of Ammonia, which possibly stimulate the secreting cells, and are excreted by them along with an increased amount of water, as we see in the kidney; Antimony; some or all of the aromatic substances in a degree, especially Camphor; and several empirical remedies, viz. Serpentary, Sassafras, Sarsaparilla, Guaiacum, Mezereon, and Senega.

It will be observed that several of our powerful diaphoretics act on more than one part of the perspiratory mechanism. Thus Alcohol dilates the cutaneous vessels, increases the rate of blood-flow through the skin, and stimulates both the afferent nerves and the centres of perspiration. Warm applications to the skin and hot drinks also influence both the circulatory and the perspiratory part of the refrigerating function; and by a combination of these and other means we may produce a very powerful effect. When this is the result, and the sweat flows abundantly from the surface, the measures and result are said to be **sudorific** (*sudor*, sweat, and *facio*, I make.)

(*b*) *Measures which diminish* the amount of perspiration are called **anhidrotics** (ἀν, priv., and ἱδρῶς, sweat.) Some of these act upon the *afferent* nerves, especially moderate local cold, obtained by fanning, light clothing, and a cool atmosphere generally; and sponging with cool, tepid, or even hot water. Others depress the perspiratory *centre*—possibly in part directly, certainly indirectly by strengthening the heart and respiration, and thus reducing the venosity of the blood which powerfully stimulates it. Such are food, which is one of the best means of preventing the "cold sweats," of exhausting diseases, Alcohol, Ammonia, Strychnia, Iron, and fresh air or good ventilation. The *efferent* sweat-nerves may possibly be depressed by Opium, which in certain combinations, *e.g.* with Diluted Sulphuric Acid, is an anhidrotic, acting either in this or some unknown way. By far the most powerful anhidrotic drugs act upon the *terminations* of the perspiratory nerves in the glands, namely, Atropia and Hyoscyamia. The effect of these alkaloids or of the Extract of Belladonna is very marked. Measures which contract the blood-vessels of the glands, will *pro tanto* be anhidrotic also. Such are — sponging with solutions of Sulphuric Acid and Water, or of Tannin, which constringe the parts, and Oxide of Zinc, given internally.

Lastly, the *modus operandi* of certain anhidrotics is still doubtful, and their employment so far empirical, *e.g.* Zinc, Quinia, and Opium under particular circumstances. It is possible, however, that these and other measures control the pathological cause of the sweats, in a manner to be afterwards indicated.

4. *Other Channels of Loss of Heat.*—The kidneys and the bowels afford us a direct means of reducing the temperature of the body by the abstraction of an increased amount of warm excretions, in the form of urine and watery motions. In the case of the bowels the effect is decidedly assisted by the reflex dilatation of the cutaneous vessels which accompanies purgation, as described in chapter vi.

5. *The Heat-forming Tissues.*—In discussing metabolism in chapter ix., we found that we possess the power of diminishing tissue change, and the production of heat, by various means. Here we shall refer only to certain drugs which possess this action. We call these **antipyretics** (*ἀντί*, against, *πυρετὸς*, fever). The most powerful of these is Cinchona (Quinia), which interferes with metabolism generally, lessens the amount of heat produced, diminishes the excretions, and spares the organs. Salicin and Salicylic Acid, Resorcin, Chinolin, and Kairin, have a similar but less powerful action. Whilst these drugs distinctly reduce or spare the activity of the tissues, they have but little influence in reducing the temperature of healthy individuals, this effect probably being prevented by the ordinary mechanisms of regulation. Alcohol also diminishes tissue waste, apparently in a different way from Quinia, viz. by being itself decomposed in the tissues with great readiness, thus sparing the organs. Even an increased amount of heat is generated in the tissues by the oxydation of Alcohol, but so greatly does it stimulate refrigeration, as we have seen, that its total effect on the organism is antipyretic. The Aromatic substances have a less powerful influence in diminishing metabolism. Possibly, Digitalis, Aconite, and Veratria, have also an antipyretic effect, like Alcohol, but their mode of action is obscure, unless it occur entirely through the circulation, as has been already suggested.

III. Pathological Relations.

The mechanism concerned in the regulation of the body-heat is liable to disorder, when heat-forming or heat-losing organs are diseased. Elevation of the body temperature, or *pyrexia*, most commonly called *fever*, is very rarely absent in illness of any consequence. An abnormal fall is seen as an effect of extreme cold or of exhausting diseases, but being

comparatively insignificant does not require to be discussed here.

Pyrexia.—The temperature of the body may be abnormally raised in several ways. Thus we meet with excessive pyrexia in injury or disease of the *heat-centre* or *tracts*, especially injury of the cervical and dorsal regions of the spinal cord. *Exposure to excessive heat* induces "heat-fever," a variety of sunstroke which is common in India. More familiar to us is fever brought on by *interference with the refrigerating function of the skin*, as the effect of exposure to cold or damp. This is known as a "chill." A powerful impression of cold on the afferent nerves of temperature appears to throw the regulating mechanism into disorder; perspiration is arrested; the cutaneous vessels are spasmodically contracted; rigors, shivers, or chilly feelings ensue; and the heat thus retained in the blood quickly raises the temperature.

Increased production of heat at one focus, such as an inflamed part, contributes in an insignificant degree to the accompanying fever.

The increased production of heat in the tissues generally which is probably present in all kinds of fever, whatever its cause, is no doubt the principal origin of the pyrexia. The increased activity of metabolism is proved by the rapid wasting of the tissues, by the increase of urea and other excretions, and by the pyrexia as tested by the thermometer—all obvious phenomena in every case attended by fever.

In the specific fevers there is at work, however, another cause of oxydation of the tissues, which furnishes an *extraneous* addition to the body heat. We now believe that many diseases, such as typhoid fever, small-pox, and septicæmia, are associated with the presence of organisms in the tissues, if not actually caused by them. The life of such organisms, the processes of fermentation with which they are associated, and the destruction of the tissues which they produce, must all be a considerable source of heat within the body, in a way perfectly foreign to the normal processes, though closely resembling some of them.

A combination of several of the preceding causes is commonly at work in fever. Thus, when a patient has a local wound which acts as a focus of heat, the pus may decompose, *i.e.* become infected by organisms; these are absorbed into and flourish in the blood; fresh foci of disease are set up in the tissues; and the natural refrigeration of the blood is reduced by the disturbances of the skin, lungs, and circulation, which always accompany serious illness.

Disorders of Perspiration.—Only two disorders of perspira-

tion concern us here, viz. (1) *excessive sweating*, and (2) *deficient sweating*.

1. *Excessive sweating*, *hidrosis*, *hyperidrosis*, is found in a great variety of morbid conditions. In some kinds of fever, such as rheumatism, its pathology is bound up with the pathology of the fever as a whole. In disorders of respiration, as we have seen, dyspnœal sweats are due to stimulation of the sweat-centres by venous blood. The "cold" sweats of wasting diseases such as phthisis, especially during sleep, appear to be due to the same cause, associated with anæmia and coldness of the skin, which prevent evaporation and "insensible perspiration," and thus give rise to a profuse collection of visible sweat as well as great depression of the bodily strength from interference with the cutaneous excretion. "Critical" sweats are referred to sudden changes in the disturbance of the vaso-motor system of the skin present in fever. Toxic sweating, as is seen in alcoholism and gout, may obviously be variously induced.

2. *Deficient sweating : anhidrosis.*—Dryness of the skin occurs at the beginning of most fevers, and throughout the course of most of them more or less interruptedly. It is also marked in some diseases and disorders of the urinary functions, such as Bright's disease and diabetes; in certain diseases of the skin itself; and as the result of poisoning by atropia (belladonna), etc. Manifestly different parts of the nervo-glandular apparatus are disordered in the different cases.

IV. Natural Recovery.

Disorders of the body heat being disturbances of a regulating mechanism, that is, of one means of natural recovery, we can hardly expect to find at work in fever those very provisions which have been interfered with. For the same reason, the temperature of the body generally returns to the normal on the cessation of the cause of the fever, either spontaneously or with the artificial assistance of the therapeutist. Occasionally the temperature rises beyond all control—to 107°, 110°, and even higher, and the subject dies of the effects of excessive heat or *hyperpyrexia*. In most instances of death from fever, however, the fatal result is due to one of the other factors of fever, especially the body waste.

V. Therapeutics.

A great part of our knowledge of the body heat, its regulation and its disturbances, has been derived from careful observation of the results of treatment; and the use of measures to control fever—antipyretics or **febrifuges** (*febris*, fever, and

fugo, I drive away,) is one of the most successful, as well as rational, of therapeutical proceedings.

1. *Preventive Treatment: Antiperiodics.*—The periodical return of fever may be prevented by means of **antiperiodics.** The most powerful of these is Cinchona, with its constituents, especially Quinia; Salicin, Salicylic Acid, and Chinolin, are not so powerful; less important are Nectandra and its alkaloid Beberia.

2. *Immediate treatment.*—With the abundant means at our command which we have discussed in the second section, the immediate treatment of pyrexia is very easy, inasmuch as we can lower the temperature of the surface of the body to any degree we please; for instance, by the cold bath. But we soon discover that it is one thing to reduce pyrexia, and another thing to treat fever. We can readily assist the refrigerating mechanism of the body, and we can even so far reduce the metabolic activity of the tissues, but our remedies can rarely reach the actual cause of the disorder, and the temperature rises again. As far as possible, however, we are bound to begin by discovering and attacking the causes; and if we fail in this, we must then combat the fever itself, so as to prevent its injurious effects on the system.

(*a*) *Injury or disease of the nervous system*, as a cause of pyrexia, is generally beyond treatment. If the temperature rise to a dangerous height, it must be treated by the refrigerating measures presently to be described.

(*b*) *Heat-fever* is rationally treated by immediate removal of the patient to a cool, open atmosphere, and the application of refrigeration, in the form of cold affusion.

(*c*) *Interference with the cooling function of the skin* is rationally treated by increasing the loss of heat by refrigerants, Refrigeration is practically carried out by lowering the temperature of the external medium, by increasing the cutaneous circulation, and by stimulating the secretions, by the warm bath; hot, spiced alcoholic drinks, a brisk purgative.

When fever rises high, the temperature of the room must be kept low; the skin sponged; and if the pyrexia rise to a dangerous height, the prolonged cold bath or wet pack must be employed according to the method described in chapter xiv.

Diaphoretics are chiefly employed as refrigerants in symptomatic fevers, *i.e.* in the pyrexia attending ordinary local inflammation of the lungs, bronchi, fauces, or other parts. Alcohol, Hot Water, Liquor Ammoniæ Acetatis, Ipecacuanha and Opium in the form of Dover's Powder, Antimony as the

Pulvis Antimonialis or Vinum Antimoniale, and Tincture of Aconite are the drugs chiefly used to provoke perspiration in fever. With these, the use of the warm bath may be combined.

(*d*) *A focus* of increased heat-production, such as an abscess, must be removed as soon as possible.

(*e*) *Increased metabolism generally*, which is the principal cause of pyrexia, is rationally treated by Quinia, Salicin, Alcohol, the Phenol Derivates, and Aromatic Substances. The rule commonly followed is to give a single large dose of quinia, say 10 grains, when the temperature rises above a certain point—104° or 105°, according to circumstances; or repeated moderate doses or a single large dose may be given in anticipation of the exacerbation. Ague is thus combated by Quinia, and rheumatism by Salicin or the Salicylates.

(*f*) *Foreign organisms or substances in the system.*—Fever produced by these bodies and their life-processes would be rationally treated by destroying them. We attempt to do so by administering internally some of the substances which are destructive to lowly organised life apart from the body, or in wounds on the surface of the body—the antiseptics and disinfectants, and which may be named **disinfectant antipyretics.** The value of Quinia in ague is so great, that it is referred to a specific influence upon the organism of the disease. The powerful effect of Salicin upon rheumatism has been similarly explained.

(*g*) *Combinations of causes.*—Just as fever is generally traceable to a combination of the preceding causes, so it must, as a rule, be treated by the application of remedies which act in several ways, or by a combination of antipyretic measures. Thus Alcohol will be indicated in many cases of fever, because it dilates the vessels of the skin, increases the circulation through them, and stimulates the sweat glands, whilst it spares tissue damage, and acts as an antiseptic antipyretic. Quinia will be employed with advantage when the temperature mounts high, since it controls the metabolism not only of the animal tissues, but of the septic and foreign organisms which may be wasting these. Indeed all the measures which we have analysed under the preceding heads are to be freely combined, constituting the general treatment of fever. An abundant supply of nutritious and digestible food is essential, to compensate for the great increase of metabolism which is going on. Alcohol is a true food, easily taken, rapidly assimilated, and yielding abundance of energy at little cost to the tissues, and therefore it is in general use in fevers, although it is by no means an indispensable remedy.

Synopsis of Substances Acting on the Body Heat.

Antipyretics.	Antiperiodics.	Refrigerants.	Anhidrotics.
Antimonium	Quinia	*Stimulants of the Cutaneous Circulation.*	Quinia
Acidum Salicyl.	Acid. Arsenios.		Belladonna
Salicin	Piper		Stramonium
Benzoinum	Eucalyptus		Hyoscyamus
Storax	? Resorcin		Alcohol, Evaporating
Camphora		Digitalis	Acids, locally in solution
Nectandra		Scilla	Ergota
Beberia		Alcohol	Picrotoxin
Piper	Diaphoretics.		Zinci Oxidum
Quinia		*Dilators of Cutaneous Vessels.*	Acidum Sulphuricum Dilutum
Opium	Jaborandi		Acidum Salicylicum
Arnica	Opium	Chloral Hydras	
Lobelia	Antimonium	Digitalis	
Alcohol	Resorcin	Scilla	
Resorcin	Aqua	Alcohol	
Chinolin	Ipecacuanha	Veratria	
Trimethylamin	Senega		
Kairin	Camphora		
Aconitum	Cubeba		
Acids	Colchicum		
Eucalyptus	Salicin		
Chloral Hydras	Acid. Salic.		
Veratria	Lobelia		
Colchicum	Arnica		
	Alcohol		
	Aconitum		
	Pot. Citras		
	Pot. Nitras		
	Am. Acet. Liq.		
	Am. Chloridum		
	Am. Cit. Liq.		

CHAPTER XV.

THERAPEUTICAL PROCESSES CONNECTED WITH THE SURFACE OF THE BODY.

The surface of the body is of great interest and importance to the therapeutist, because it is the region of objective impressions, where influences of every kind may be brought in contact with nerves and vessels, and through them with the nervous centres, the circulation generally, and indeed the entire system. The measures applied to this part appear at first sight to be very simple, but their action is, on the contrary,

extremely complex, and indeed still very obscure. On this account we have taken them last in the whole range of remedies, and it will be found that they involve all the systems already discussed, especially the nervous and circulatory. As a group they are very heterogeneous, and we will select for special consideration three distinct subjects, namely (1) *Counter-irritants*, such as blisters; (2) *Baths;* and (3) *Surgical Applications.*

I. Physiological Relations.—The physiological relations of the surface of the body have already been studied under several distinct heads.

The *nerves* are connected not only with the sensorium, but with the vital centres which regulate the vessels and viscera. The cutaneous *vessels* have equally extensive relations. They have the usual nutritive function; they are the great refrigerating apparatus of the body; and they also serve as a great external blood-reservoir, in connection with the systemic circulation.

II. Pharmacodynamics.—When the classes of measures given at the ends of the chapters on the circulation and nervous system are compared, it is found that several of them act on both, and that their action may be different or even opposite according to the time for which they are applied. For these and other reasons, a number of them have been collected into a special class, and called

Counter-irritants.—These measures may be thus arranged, according to the degree of their action:

1. **Rubefacients** (*rubere*, to be red, and *facere*, to make) cause increased redness and heat of the parts. Such are Hot Water; Mustard, and its preparations; Ammonia, and its preparations; the confined vapour of Chloroform, Ether, and Alcohol; all Volatile Oils, especially Turpentine, Camphor, Menthol and Thymol; Iodine carefully applied; Emplastrum Picis; and Emplastrum Calefaciens.

2. **Vesicants** (*vesica*, a blister), **Epispastics** (ἐπι, upon, and σπάω, I draw), or **Blisters**, produce a rubefacient effect, followed by the development of a blister. They include Cantharides, Mezereon, Ammonia long applied or confined, Iodine, Oil or Compound Liniment of Mustard, and Scalding Water.

3. **Pustulants** (*pus*, matter) produce a crop of pimples. They are a small group, consisting of Croton Oil, Tartar Emetic, Nitrate of Silver in strong solution, and Ipecacuanha.

Phenomena of counter-irritation.—When a counter-irritant is applied to the skin, the *first* effect is *rubefacient* and stimulant. The cutaneous vessels are dilated by a direct action on their nerves, and the local circulation becomes more free; whilst the irritation of the sensory nerves causes pain of a hot burning character. The cardiac action is accelerated, the cutaneous vessels generally reflexly contracted, the blood pressure rises, the temperature is elevated, and the breathing slowed. The highest centres are also roused by the painful impression: perception, consciousness, and the emotions are variously disturbed. Cutaneous anæsthesia follows: the nerves are depressed, pain is relieved, excepting that caused by the application itself.

Prolonged application is generally required to induce the *second* degree of counter-irritation—*vesication.* The reddened area now becomes inflamed; plasma escapes from the vessels, followed by corpuscles; the epidermis is raised, and a vesicle is formed containing a quantity of fluid. The previous anæsthesia is now replaced by considerable local pain, which, if extensive, may depress the viscera—weakening and slowing the heart, lowering the pulse, further slowing the respiration, lowering the temperature and diminishing nervous energy.

The *third* degree of counter-irritation, *pustulation*, is different in kind from vesication as well as more severe, the result being not uniform inflammation, but a crop of painful, "angry" pimples or pustules, which are very slow to heal. The remote effects are the same as before, but greater.

Theory of the action of counter-irritation.—Such are the phenomena of this method, obvious to all. But it is held by some that not only the functional activity, but the *nutrition* of internal parts may be affected by means of it. The doctrine of counter-irritation may be said to be, that when a part at some distance beneath the surface of the body, such as a joint, or even remote from it, such as the lungs, is in a condition of inflammation, pain, unnatural activity, or overgrowth, an alterative effect may be produced upon its nutrition, by altering the condition of an area of skin superficial to it, or even at a distance from it. A second or "counter" seat of "irritation" is set up to relieve the deeper and more vital part. Now we may conclude with respect to this theory:

1. That rubefacients and vesicants will afford relief to the circulation of parts in immediate vascular connection with the selected area, by attracting blood and draining off plasma; to the same extent the general circulation will be depressed, and visceral congestion or inflammation will be diminished. At the same time the heart will be relieved.

2. That the irritation of the cutaneous nerves will modify in a simple reflex way, through the centres in the brain and cord, the circulation and nutrition generally, of the parts beneath; the impression which passes in being immediately reflected along the vascular or trophic nerves.

3. That possibly the irritation of the local nerves and vessels may affect the vaso-motor and trophic centres in the brain and cord, presiding over the area of skin; and that this disturbance may so influence a neighbouring trophic centre (say of a joint) as to produce through it a change in the nutrition of the tissues (such as a joint) in the neighbourhood of the area to which the irritant was applied.

4. That vesicants and pustulants may produce a flow of plasma or pus, which will relieve the blood or tissues of organised or other poisons, which are the cause of the disease. This is the old humoral view, founded on the pathology that "humours of the blood" are the origin of disease.

III. Pathological Relations and Therapeutics.—The pathological conditions which we seek to influence by counter-irritants belong to various systems, which have been already discussed. The same remark holds true of the therapeutical applications of the principles just examined. All that remains to be done here is to enumerate the chief morbid conditions which may be treated by counter-irritation. These are, (1) Subacute or chronic inflammation, with or without unnatural growth, of parts in direct vascular connection with the skin; *e.g.* of a joint or bone. (2) Congestion or inflammation in neighbouring viscera; *e.g.* of the lungs. (3) Pain in deep or distant parts, such as neuralgic, cardiac, or renal pain. (4) Spasm, or other morbid activity in deep muscular structures, such as lumbago and vomiting. (5) Central nervous disturbances such as syncope and hysteria.

Baths and Allied Measures.—The principles on which the use of baths depend are in a great measure identical with those which we have already discussed, and do not require to be repeated. If the student will carefully bear in mind the relations of the vessels and nerves of the skin to the body heat, circulation generally, and nervous system, he will readily appreciate the subject of baths from the following tables, which give a list of the most common baths, together with their action and principal uses succinctly arranged.

I. Water Baths.

Name.	Temperature.	Action.	Uses.
Cold.	32° to 60°	Cools blood in cutaneous vessels; stimulates heart, respiration, etc., reflexly. Temporarily overfills internal vessels, thus raising blood pressure.	Refrigerant in fever. Refreshing: The morning bath.
Cool.	60° „ 70°	The same, but less marked.	The same in weaker subjects.
Tepid.	85° „ 95°	Detergent (cleansing), physically and chemically; soothes the nerves.	Ordinary personal cleanliness. Allays restlessness of fever and lowers temperature.
Warm.	95° „ 100°	Raises local temperature; stimulates local circulation; stimulates glands, increasing discharge of warm secretions, and evaporation; soothes the nerves and the corresponding centres.	Diaphoretic in fever; diaphoretic in uræmia; anodyne; antispasmodic.
Hot.	100° „ 106°	The same, but more marked.	The same, but is more powerful.
„ Local.	„ „	Attracts blood *to* part bathed.	To stimulate menstrual flow.
„ „	„ „	Attracts blood *from* distant parts.	To relieve internal congestions, as in catarrh and apoplexy.

II. Vapour Baths.

Name.	Temperature.	Action.	Uses.
Simple Vapour or Russian.	95 to 110°	Much like the warm or hot bath, but slower, and at higher temperature.	Much like the warm bath. A powerful diaphoretic.
Medicated watery Vapour.	„ „	The action chiefly of aromatics.	Stimulant and antispasmodic.
Fumigations.	Various.	Specific (Mercury, Sulphur, etc.).	Specific.

III. Air Baths.

Name.	Temperature.	Action.	Uses.
Hot air, or Turkish.	Up to 220°, followed by cold.	Diaphoretic, followed by stimulation; anodyne; increases metabolism.	Like warm water and Russian baths. Tonic.
Compressed air.	Ordinary.	Increases oxygenation.	Diseases of the lungs and heart.

IV. Medicated Baths.

Name.	Temperature.	Action.	Uses.
Natural.	That of the spring.	Specific.	Gout, rheumatism, syphilis, skin diseases, etc.
Sea.	Various.	Stimulant.	Invigorating.
Artificial.	Various.	Specific, *e.g.* Nitro-hydrochloric Acid, Sulphide of Potassium, and Mercurial solutions.	As alterative in hepatic disease, rheumatism, syphilis, plumbism, scabies, and other skin diseases.

V. Complex Baths.

Name.	Temperature.	Action.	Uses.
Mercurial vapour.	Sufficient to vaporise water and mercurial.	Specific.	Syphilis.
Mercurial hot air.	Sufficient to vaporise mercurial.	Specific.	Syphilis.
Mud, pine, bran, etc.		Various.	Various.

The cold bath in fever.—A simple tepid water bath is prepared, at a temperature of about 90°; the patient is carefully placed in it; and cold water is added until the thermometer falls

to 80° or even 40°, according to circumstances. Here the patient remains for 10 to 20 minutes, his temperature being taken during immersion, or if any shivering occurs, he is at once removed. He is then wiped dry, placed in bed, and covered with blankets. A stimulant may be required. The cold bath may be repeated several times a day, if indicated.

In very urgent or desperate cases the cold bath may be increased in activity by lowering the temperature to freezing point by ice, and by prolonged immersion, even to three hours. This treatment requires great care and judgment.

The douche, affusion, and shower bath. — The stimulant action of water may be greatly increased by directing it against the body in a single or divided stream. The size, height, direction, and temperature of the stream, the part and extent of surface to which it is applied, have great influence upon the effect of the douche. The *uses* of the shower bath are chiefly in hysteria and mania; of the local douche in loss of sensibility of parts, chronic enlargements of joints or bones, and sprains. Affusion is of value in convulsions, sunstroke, mania, hysteria, and as a means of resuscitation.

The Wet Pack.—Prepare a bed by spreading two blankets on the mattress and over the pillow of an ordinary single bedstead. Thoroughly wet a linen sheet with cold water, and spread it smooth over the blankets. Strip the patient, place him flat on his back on the wet sheet with his head on the pillow, and envelop him in the sheet and blankets, by bringing these one side at a time across his body, and tucking them under the opposite side and under the heels. Finally cover him with several more blankets, and again tuck these closely round him. The ordinary duration of packing is a quarter of an hour to an hour. The pack is then removed, and the skin rubbed with a dry towel. The pack may be repeated several times a day if necessary.

The first sense of chilliness produced by the wet sheet is quickly replaced by a delightful glow. The physiological action of the wet pack is chiefly on the refrigerating function of the skin: heat is abstracted so that the temperature quickly falls; the frequency and force of the pulse decline; the central nervous system is soothed both through the nerves and through the circulation, and by the refrigeration; sensibility, pain, irritability, and delirium, are dispelled; and sleep often follows immediately.

The *use* of the wet pack is almost confined to the specific fevers, such as scarlatina and typhoid, when the pyrexia is excessive, delirium high, and the rash ill-developed.

The Treatment of Wounds.

1. **Antiseptics** prevent putrefaction in a wound by virtue of their action in arresting the growth of organisms, or destroying these or the chemical activity of certain substances which give rise to fermentation and decomposition. They include: Carbolic Acid, Creasote, Boracic Acid, Iodoform, Iodine, Eucalyptus, Thymol, Salicylic Acid, Quinia, Sulphurous Acid, Perchloride of Mercury, Chloride of Zinc, Alcohol, Permanganate of Potash, Turpentine, Benzoin, Balsam of Tolu, and Balsam of Peru.

2. **Disinfectants** are substances which destroy micro-organisms, or active chemical substances and their products, on surfaces already foul or infected. They are for the most part the same materials as the antiseptics, but are employed in a much stronger form. Such are strong solutions of Chloride of Zinc and Carbolic Acid, Iodoform, Iodine, Sulphurous Acid.

3. **Deodorants** absorb gases and neutralise foul odours. Those chiefly used are Charcoal, Permanganate of Potash, and Iodoform.

4. **Astringents** coagulate or precipitate the albuminous discharges, coagulate the germinal protoplasm of the upper layers of cells, and either directly contract or indirectly constringe the vessels, so as to limit exudation. They are used to check excessive discharge and granulation growth; and thus give tone to wounds. Astringents include: Solutions of Nitrate of Silver, Subacetate and Acetate of Lead, Sulphate of Zinc, Sulphate of Copper, Alum, Persalts of Iron, Tannic Acid and its allies, and Carbolic Acid.

5. **Stimulants** are for the most part mild astringents, applied chiefly in the form of lotion; such as weak solutions of Nitrate of Silver, Sulphate of Copper, Sulphate of Zinc, Carbolic Acid, etc. They are more efficacious as weak spirituous solutions. Stimulants are used to wounds when healing flags or the granulations tend to become prominent.

6. **Styptics** are applied to wounds to check hæmorrhage. They include: Ice, Persalts of Iron, Nitrate of Silver, Matico, Tannic acid.

7. **Caustics and Escharotics** are intended to destroy part

of the living tissues, and thus destroy or arrest the activity of organic poisons, as in bites, dissection wounds, syphilis, malignant disease, and gangrenous processes. They include: Caustic Alkalies, Mineral Acids, Solution of Chloride of Antimony, Chloride of Zinc, Nitrate of Silver, Sulphate of Copper, Arsenic, Acid Nitrate of Mercury, and Dried Alum.

8. **Vesicants** are applied to chronic ulcerating surfaces to stimulate the circulation in the surrounding parts, and soften callous edges. Cantharides is chiefly used.

9. **Anodynes** are intended to alleviate the pain of wounds and ulcers, and induce sleep. The medicinal anodynes commonly thus applied are preparations of Opium and Belladonna.

APPENDIX.

Substances which act on the Pupil.

Pupil Dilators: Mydriatics.	Pupil Contractors: Myotics.
Belladonna Atropia Stramonium Hyoscyamus Hyoscyamia Duboisia Homatropin Gelsemium	Physostigma Eserin Jaborandi Pilocarpin Opium Morphia

Substances which act upon the Generative Organs.

Substances which stimulate the non-gravid Uterus: Emmenagogues.	Substances which stimulate the Gravid Uterus: Ecbolics: Oxytocics.	Substances which depress the Uterus.
Myrrha Aloes Ergota Sabina Ruta Alcohol Cantharis Digitalis Actæa Racemosa Purgatives Hematinics Tonics	Ergota Sabina Ruta Pilocarpin Drastic Purgatives	Bromides Opium Chloral Hydras Cannabis Indica Chloroformum Antimonium Tartaratum Tabacum Cupri Sulphas Emetics

Substances which stimulate the Sexual Organs: Aphrodisiacs.	Substances which depress the Sexual Organs: Anaphrodisiacs.
Camphora (at first) Opium ,, Cannabis Indica Nux Vomica Strychnia Phosphorus Cantharis Alcohol Lupulus Hæmatinics Tonics	Bromides Camphora (at last) Opium ,, Tabacum Belladonna Hyoscyamus Stramonium Circulatory Depressants

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